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THE PROBABLE INFLUENCE OF DISTURBED NUTRITION ON THE EVOLUTION OF THE VEGETATIVE PHASE OF THE SPOROPHYTE.

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In this paper the discussion of the influence of nutrition, applies chiefly to that source of nutrition in plant organs provided with chlorophyll, and presupposes, in general, that the ordinary physiological processes, other than the one which is termed carbon assimilation, are normal. In all such plants some development of this vegetative part of the plant must take place before spore production, or fruiting, of a kind which represents a real increase at the time, can be accomplished. Some apparent, but not real, exceptions to this might be noted. In germination of the spores of Oedogonium, frequently spore production takes place without the development of any such vegetative part of the plant, but there is no real increase of the plant substance. This kind of spore production is only a means, perhaps, to tide over some condition unfavorable for the elaboration of the vegetative phase of the plant, which is present at the time and place. In Coleochæte, germination of the oospore results in the formation of a cellular mass, which

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is larger than the oospore, breaks the enclosing wall, and the cells escape as a number of zoospores in place of one. But in this oospore are the stored products of carbon assimilation of the parent chlorophyll phase of the plant, and this case only differs from that of the Bryophyta, in that the sporophyte becomes separated, with stored products, from the gametophyte, before the differentiation of the spores.

In the higher plants many cases of bulbs, corms, tubers, etc., might be cited to show that the development of the sporophylls, and even fruit, might take place without the accompaniment of chylorophyll bearing organs. But here also the bulbs, corms, etc., represent, in the stored products of carbon assimilation, the preceeding green leaves. In certain ferns, as Osmunda cinnamomea, the sporophyll, which is completely differentiated from the vegetative leaf, appears first in the spring, and could mature its spores without the aid of the vegetative leaves of that season, but the green leaves of the previous season formed the necessary carbohydrates, which are stored in the rhizome and rudimentary leaves during the winter and in fact the sporophylls and sporangia are partly developed at the close of the previous season.

We might say, then, that in general, all spore production in plants, which themselves assimilate carbon dioxide, is necessarily preceeded by a greater or lesser development of chlorophyll bearing organs. This may appear to be a too well known axiom for even the brief discussion here given, but it is necessary in view of what is to come to have this axiom well in mind. Chlorophyll bearing organs, or tissues, then, as compared with sporogenous organs or tissues, are, in point of time within the life cyle, *primary*, while the latter are *secondary*. This proposition should not be regarded as opposed to the primary evolution of the sporophylls as compared with the foliar organs of the sporophyte. It applies only to a comparatively limited extent of time; to the usual cycle between the vegetative and fruiting phases; to the ontogenetic, not to the phylogenetic, development. It applies with equal force to plants in which either the gametophyte or the sporophyte forms the chlorophyll bearing organ.

There is a strong tendency in nature to an economy in the distribution of the food supply between foliar, and sporophyllary, organs; between the vegetative and fruit products of the plant. This is well seen in the varying sizes of plants having varying amounts of food supply, where with limited food supply small plants have few and small leaves accompanied by a limited out-put of fruit (other conditions are considered normal); while with increasing amounts of food, other things being equal, each of these plant products is increased, though not in the same ratio. With high feeding the vegetative increase shows a higher ratio than the fruiting. The food may be so abnormally abundant as to cause an abnormally abundant vegetative growth, accompanied in some cases with rudimentary fruit, or in others with the entire suppression of the fruit. In some rare cases it may be accompanied by the transformation of the sporophyllary organs to vegetative ones.

These facts teach that the fruit product, or sporophyllary development of plants is very sensitive to food supply, requiring a certain amount of food for perfection in even small quantities, increasing with additional food supply up to a given point, when it decreases again to zero; or in rare cases the sporophyllary organ may be transformed to a vegetative one, so antagonistic has the ratio between the vegetative and sporophyllary organs become because of the abnormally favorable conditions for vegetative growth. In addition to the sensitiveness which the fruit organs exhibit to varying amounts of food derived from the soil, they are very sensitive to disturbances in the supply of carbohydrates as a result of carbon assimilation in the vegetative organs, especially of a kind which partly or completely cuts off that supply. This is well seen in the diminished crops as a result of injury to the leaves at critical periods from insects or fungi, or as result of unfavorable meteorological conditions.

When the nutritive supply of the carbohydrates is suddenly disturbed by certain kinds and amounts of injury to the foliage leaves, or by pruning severely, thus cutting off a large number of forming or developed leaves, certain parts of the plant, either simple or in a rudimentary condition of development,

have the function of carbon assimilation forced upon them to save the plant from destruction and to provide for the development of the fruiting organs. As is well known, latent buds, which have been in a dormant condition, may be, for years, are frequently in such cases stimulated to development and form leafy shoots. It is a very common occurrence as a result of severe pruning or of injury to the ordinary leaves for young flower axes, or buds, to develop leafy shoots with other flower buds in the new leaf axils. There is a tendency here to force the vegetative function upon the young flower axes, and if this influence is felt before the specialized character of the floral organs has been developed from the cells at the apex of the axis, the development of these organs will be deferred, while these cells assume the form and function of vegetative organs. This is a matter, perhaps, of common observation as a result of severe pruning, and in some plants can be very easily demonstrated by trial. But it serves well to show the influence of disturbed nutrition on other or dormant parts of the plant when the function of the existing vegetative leaves is arrested. That function is forced from the ordinary and well developed organs upon undeveloped or rudimentary ones, which readily under this influence adapt themselves to continue this important office. This must not be regarded as an attempt to explain the development of adventitious or supernumerary buds, etc., or latent buds, in all cases, into leaf branches. Local stimuli, and a number of other causes at times, call forth leafy shoots from these. Nevertheless, in view of what has been said above, the following proposition might be formulated. Nutrition disturbed, and the development of the fruit product of the plant being threatened, by the loss of carbon-assimilating organs, the function of the latter may be taken up by some other part of the plant, either rudimentary or undifferentiated, their development into said organs being a direct result of that disturbance.

In the cases dealt with above, the function is either transferred to latent vegetative organs, or to undifferentiated tissues. It is, therefore, simply and easily comprehended. Observations have been made, however, which tend to show that in

the Angiosperms the vegetative function can be assumed not only by the floral envelopes, but also by the sporophyllary organs, more commonly by the macrosporophylls, or gynæcium. In some cases these open and expand into green leaves with the ovules, in a more or less imperfect stage of development, exposed. Perhaps no definite experiments have been carried out to demonstrate the cause of this transformation of form and function. It is supposed to be due to either excessive nutrition, or to some injury to the vegetative system of the plant. While such cases are unsatisfactory because of the lack of definite tests, they indicate that the sporophylls can assume the form and function of foliar organs when there is a disturbance of nutrition of a kind considered above. Since these sporophylls are, from a morphological standpoint, considered homologous with the green leaves, this change of function is not incompatible with that theory.

In the Pteridophytes direct experimentation proves beyond a doubt, that the sporophylls can be made to assume the form and function of the foliar organs by cutting off the latter, thus disturbing the nutrition and forcing the vegetation function on the sporophylls. The experiments performed upon *Onoclea sensibilis* and *O. struthiopteris* may be cited. In these cases after cutting off the early developed vegetative leaves the sporophylls appeared later in all stages of transformation, some complete vegetative leaves with only vestigial remnants in the form of rudimentary indusia to indicate to which series of organs they primarily belonged in the ontogeny of the plant. Between these and perfect sporophylls all gradations of intermediate forms occurred, the terminal portions of the sporophyll and of the pinnæ always being more fully expanded, while the basal portions of the same partook more or less completely of the true sporophyll. The details of the experiment and of the gradations of the development are given elsewhere, and cannot be dwelt upon here.

As an outgrowth of these experiments and observations a second proposition may be formulated as follows. Disturbed nutrition, resulting from the loss of the carbon assimilating organs of the sporophyte (vegetative leaves), may, and does,

force the vegetative function on the sporophylls, causing them to develop into more or less complete vegetative leaves.

The experiments on Onoclea convince me that there are a number of Pteridophytes, as well as Phanerogams, which would yield the same results following the amputation of their leaves, when carefully conducted, especially in those plants where, during one season, the vegetative leaves are developed sometime in advance of the sporophylls. Plants like some of the Lycopods would make extremely interesting ones to work with, and especially in the case of some of these should I expect to see a transformation of the sporophylls into vegetative leaves. This would be entirely in harmony with the relation and development of these organs. In species of Lycopodium and Selaginella all gradations between sporophylls with normal sporangia and the vegetative leaves can be found. The transitional stages are marked by the gradual degeneration of the sporangia on some of the leaves, the sporophyllary character being shown only by vestiges of the sporangia. Bower has shown how the strobilus of the Lycopods elongating by apical growth would result in the increase in the number of the sporophylls, and that the demand thus made on the vegetative system for nutrition would result in the transformation of some of the sporophylls to foliage leaves, accompanied by a corresponding sterilization of some of the sporangia. Practically it would disturb the balance of nutrition between the sporophyllary and vegetative systems, the effect being the same as it would be if some of the foliage leaves were destroyed.

In view of the ultimate purpose of this paper the question must be raised here as to whether this transformation of the sporophylls to foliar organs is a case of reversion, or whether it is an advance of a primary organ to a secondary organ of the sporophyte. It is my conviction that the latter alternative is the logical and true one, that we can by experimentation demonstrate phylogeny in ontogeny. Bower[2] has called attention to the importance which must be attached to the fact that the primary function of the sporophyte was not only the production of spores, but an increasing number; that the increase in

[2] Ann. Bot., VIII, pp. 345–365, 1894.

the mass of sporongenous tissue was necessarily accompanied by a sterilization of potential portions of the mass for purposes of protection, support, and for the conduction of nutritive material. From this condition he reviews the theoretical grounds for the relegation of the spore-producing cells to a superficial position, and the eruption of outgrowths on which the sporangia are supported, citing as illustrations of the early conditions of these outgrowths the strobilus of Equisetum and Phylloglossum. From the latter he traces the development of the elongated and branched leafy stem of species of Lycopodium by continued apical growth of its strobilus, while the sporangia on some of the lower sporophylls would be arrested, and the sporophylls themselves would develop as foliage leaves. For these and similar reasons elaborated by himself, he concludes, rightly I think, that the sporophylls are, from a phylogenetic point of view, *primary*, while the foliage leaves are *secondary*.

All the evidence which we have points to the fact that in the early development of the sporophyte, it was entirely dependent upon the gametophyte for nutrition including the supply of carbohydrates. The expanded green prothalloid structure performed the same function for the sporophyte, that foliage leaves of the sporophyte do in plants where this becomes independent of the gametophyte. This is practically true now in all the thalloid liverworts, and in all the Bryophyta is the sporophyte practically dependent upon the gametophyte for this function. In most of the Pteridophytes the sporophyte is dependent upon the gametophyte for its carbohydrates during the embryo stage. In some of the Pteridophytes, in the Gymnosperms, and in the Angiosperms, the gametophyte has entirely lost the function of carbon assimilation, this function being solely performed by parts of the sporophyte.

What influences led to the gradual transfer of this function of the gametophyte to parts of the sporophyte? Nutritive disturbances have been shown to play a very important part in the formation of sporophyllary organs quantitatively, in varying ratios between the vegetative and sporophyllary structures with increased food supply; in a tendency to produce a natural

but variable equilibrium between these two functional kinds of organs; and especially in the transformation of sporophyllary organs to vegetative ones. If these disturbances, especially in the nature of partial or complete loss of carbon assimilating organs of the sporophyte produce such an effect, why should there not be a similar influence brought to bear on the sporophyte, when the same function resides solely in the gametophyte, and a disturbing element of this kind is introduced? To me there are convincing grounds for believing that this influence was a very potent, though not the only one in the early evolution of sporophytic assimilatory organs. By this I do not mean that in the Bryophyta, for example, injury to the gametophyte would now produce distinct vegetative organs on the sporophyte, which would tend to make it independent of the gametophyte. But that in the Bryophyte-like ancestors of the Pteridophytes an influence of this kind did actually take place appears to me reasonable.

In the gradual passage from an aquatic life, for which the gametophyte was better suited, to a terrestrial existence for for which it was unadapted, a disturbance of this function was introduced. This would not only assist in the sterilization of some of the sporogenous tissue, which was taking place, but there would also be a tendency to force this function upon some of the sterilized portions of the sporophyte, and to expand them into organs better adapted to this office. As eruptions in the mass of sporogenous tissue took place and sporophylls were evolved, this would be accompanied by the transferrence of the assimilatory function of the gametophyte to some of these sporophylls. Even the protophylls may have originated by the eruption of certain of the sterile portions of the sporophyte under the influence of disturbed nutrition.

The sporophyte from its nature presented greater possibilities in the way of the elaboration of a complex, robust, perennial inhabitant of terrestrial zones. Increased sporogenous tissue was necessarily accompanied with a more bulky structure, which then necessitated a differentiation of its tissue by sterilization of certain external, then internal, parts for protection and circulation. Robust types of land plants could more naturally be developed from such a phase than from the ex-

panded and delicate gametophyte. When the sporophyte had largely assumed this function of the gametophyte, and by the development of absorbing organs in the soil was enabled to live an independent existence, it became gradually established, as conditions changed, in situations where the gametophyte could not exist. It has thus become the dominating vegetative feature of most land areas, while the gametophyte in these higher forms, has become an organ entirely dependent upon the sporophyte for nourishment, or has been developed into an organ to serve a secondary purpose in the nourishment of the sporophytic embryo.

PROGRESS IN AMERICAN ORNITHOLOGY. 1886–1895.

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What I have to say here in reference to the progress in American ornithology for the past nine or ten years is prompted by the recent appearance of the second edition of *The A. O. U. Check-List of North American Birds.* Most naturalists are familiar with the first edition of this work, it having been published in 1886. It was officially promulgated by the American Ornithologists' Union, and zoologists the world over have carefully considered " The Code of Nomenclature " that formed a part of the volume. Moreover, it contained a List of North American Birds which had been prepared according to the aforesaid Code of Rules, and *classified* in accordance with the views of the majority of the committee appointed by the Union to prepare it. In so far as the orders and families of this classification were concerned, the arrangement could be appreciated at a glance by reference to the Table of Contents of the book, and, as for the List itself, it not only was intended to represent the nomenclature of the Birds, but " a classification as well " (p. 15). At the close of the volume was presented a " Hypothetical List " to which had been referred those species and subspecies the zoological status of which could not be satisfactorily determined; and following this was a list of the fossil species of North American birds.

As the years passed by a second edition of this book was

eagerly looked for by zoologists at large, but it did not make its appearance until towards the close of December, 1895. It comes to us in the same form as its predecessor, but it does not appear to be as substantially bound or printed upon as good paper. Apart from the substitution of one member of the committee for another, it is likewise gotten out under precisely similar auspices, plans, objects and general arrangement. From it, however, has been omitted the "Code of Nomenclature," but in it are included all the new existing and fossil birds known to the committee, and which were not in the first edition of the Check-List. For this and minor changes it has but 372 pages against 392 of the original volume. In its preface it contains "extracts from the Introduction to the Code of Nomenclature," intended to serve "to explain the scope and plan of the Check-List, including the method of incorporating additions."

The second edition, then, of this work may be taken as setting forth the progress in North American ornithology as understood by a committee appointed by the American Ornithologists' Union, and for a period extending between the years 1886 and 1895 inclusive. In considering this from such a standpoint, let us first take into account the number of species and subspecies added to, or subtracted from, the List of 1886, in connection with other changes, and the same for the "hypothetical list" and for the "fossil birds." After this I will consider what improvements, if any, have been made in the matter of classification.

Designating the two volumes simply by the years of their publication, as 1886 and 1895 respectively, we find that in the first group of birds presented, or the Order PYGOPODES, there were included, in 1886, *33 species* and *4 subspecies*, while in 1865 but *32 species* are given and *4 subspecies*, the change being due to the omission of *Synthliboramphus wumizusume* (Temminck's Murrelet, No. 22).

In 1886, the Great Auk (*Plautus impennis*, No. 33) was "Believed to be now extinct," while in 1895 it is confidently asserted to be "Now extinct." This being the case, we would like to inquire what place has it in a list of the *existing* birds of this or any other country? It is simply absurd to include birds that have *no existence* in nature in a list of living forms.

Passing to the second group, or Order LONGIPENNES, we find upon comparison that in 1886 it contained *44 species* and *4 subspecies,* while in 1895 it is seen to contain *46 species* and *4 subspecies.* The additions here are the two new species *Larus barrovianus* and *Larus minutus* (a straggler). Another change in this group is the calling Pallas's Gull (*Larus cachinnans,* No. 52) the Vega Gull (*Larus vegæ* [1895]).

In the third group, or the Order TUBINARES, were included, in 1886, *31 species* and *3 subspecies,* to which list was added a new species in 1895 (*Oceanodroma macrodactyla*), making *32 species* and *3 subspecies* for that year. Peale's Petrel (*Æstrelata gularis*) (No. [99]), was likewise changed to the Scaled Petrel (*Æ. scalaris*) in this group.

In 1886, the fourth group, or the Order STEGANOPODES, was made to contain *17 species* and *5 subspecies,* and, in 1895, *19 species* and *5 subspecies,* the increase being due to the addition of the two new species of Gannets, *Sula gossi* and *S. brewsteri.*

Coming to the fifth group, or the Order ANSERES, there were contained in it in the 1886 List, *51 species* and *6 subspecies,* and, in the 1895 List, *51 species* and *8 subspecies,* the change being effected as follows: *Anas fulvigula maculosa,* the Mottled Duck, was added as a new subspecies, and *Somateria mollissima* was made the subspecies *S. m. borealis*; finally, *Chen cærulescens* was included in the list. *Camptolaimus labradorius* now being "extinct," it has no place in the List and ought not to appear there.

Group six, the Order ODONTOGLOSSÆ, remains the same, each List having the *1 species* of Flamingo (*P. ruber*).

In the seventh group, or the Order HERODIONES, there were to be found *19 species* and *2 subspecies,* to which were added in the 1895 List a new species and a new subspecies (*Ardetta neoxena* and *Ardea virescens frazari*). *Botaurus exilis* becomes in the new List *Ardetta exilis,* and *Ardea rufa* becomes *A. rufescens,* while the "subgenus" *Nyctherodius* is changed to *Nyctanassa.*

The Order PALUDICOLÆ (eighth group) in the 1886 List, contained *17 species* and *3 subspecies,* to be changed in the 1895 List to *21 species* with only *1 subspecies.* This was effected by considering the subspecies *Rallus longirostris crepitans* (1886) to be the species *Rallus crepitans,* and adding also to the 1896

List the species *Rallus scottii* and *Rallus longirostris caribæus.* The subspecies *Porzana jamaicensis coturniculus* (1886) became the species *P. coturniculus* (1895). From these changes a less important one is to be noted, *viz.: Rallus longirostris saturatus* became, in 1895, *R. crepitans saturatus* (No. 211 *a*).

Passing to the Order LIMICOLÆ (ninth group), it is to be noted that in the List of 1886 there were included *66 species* and *4 subspecies*, and in 1895 these became *68 species* and *6 subspecies*, the changes being the addition of *Tringa damacensis* (a straggler); the two subspecies *Totanus solitarius cinnamomeus* and *Symphemia semipalmata inornata*, and the new species *Hæmatopus frazari*. Other changes in this group are the subgenus *Rhyacophilus* (1886) to read the subgenus *Heladromus*, and the name of the Mexican Jacana, instead of being *Jacana gymnostoma* (Wagl.), is now *J. spinosa* (Linn.).

Coming next to the Order GALLINÆ (tenth group), it is to be seen that in the 1886 List *22 species* are given and *18 subspecies*, while in 1895 there are *21 species* and *22 subspecies.* This reduction in the number of species was caused by the dropping out of *Colinus graysoni*, while the subspecies were increased by adding to the List *Oreortyx pictus confinis*, *Tympanuchus americanus attwateri*, and the two Turkeys, *M. g. osceola* and *M. g. ellioti*. *Callipepla gambeli* of the old work was corrected to read *C. gambelii*.[1]

In the eleventh group, or the Order COLUMBÆ, there were included in the List of 1886 *12 species* and no subspecies. In the 1895 List we find but *11 species*, while *4 subspecies* have been added. *Columba fasciata viosca* was recognized, while *Engyptila albifrons* (1885) became *Leptotila fulviventris brachyptera.* There was also added the subspecies *Columbigallina passerina pallescens* and the species *Columbigallina passerina* has became the subspecies *C. p. terrestris.*

There appeared *53 species* and *29 subspecies* in the twelfth group or Order RAPOTRES in 1886, while in 1895 these were increased to *54 species* and *37 subspecies.* In this group the

[1] In making these comparisons it is to be understood that they are direct between the Check-List of 1886 and that of 1895, and that the seven supplements (1889-94) and the Abridged Edition of 1889 are not taken into consideration. The second edition (1895) is taken to be the final finding of the Committee.

changes to be noted are first the addition of the subspecies *Buteo borealis harlani* (337 *d*) and the omission of *Buteo harlani* (338, 1886). *Buteo albicaudatus* becomes the subspecies *B. a. sennetti;* the subgenus TACHYTRIORCHIS being introduced between Nos. 340 and 341 in the genus *Buteo*. *Falco regulus* is added to the list (a straggler in Greenland). *Falco sparverius deserticolus* and *F. s. peninsularis,* two new subspecies of Sparrow Hawks, are also added, and *Falco sparverioides* is changed to *F. dominicensis.* *Falco tinnunculus* is also added to the 1895 List as a straggler. *Megascops asio mccallii* is now determined to be *M. a. trichopsis;* while *M. a. trichopsis* of the 1886 List now becomes *M. a. cineraceus* of 1895. Again the generic name *Ulula* is set aside for that of *Scotiaptex* of Swainson. There are also added *Megascops a. aikeni, M. a. macfarlanei, M. a. idahoensis* and *Glaucidium g. californicum* as new subspecies, and also the new species *Glaucidium hoskinsii.* The genus of Elf Owls formerly in the genus *Micrathene* have had that name replaced by *Micropallas.* The Order PSITTACI (13th group,) remains identical in the two Lists, having but the *1 species,* the Carolina Paraquet.

Following these we have the fourteenth group or COCCYZES, an Order containing the Cuckoos, Trogons and Kingfishers. All told, in 1886, there were *9 species* of these, and, in 1895, *9 species* and *4 subspecies.* These latter consist of 3 Cuckoos (*Coccyzus minor maynardi, C. americanus occidentalis* and *Cuculus canorus telephonus*), also the Texas Kingfisher (*Ceryle a. septentrionalis*). This latter was formerly *Ceryle cabanisi.* In the 1895 List *Ceryle torquata* is added [390. 1].

Next we come to the Order PICI (15th group), in which there were *23 species* and *11 subspecies* in 1886, which, in the 1895 List, stand as *22 species* and *14 subspecies.* Upon comparing the records we find that *Dryobates villosus hyloscopus* has been added as a subspecies, and also *Dryobates pubescens oreœcus. Dryobates scalaris* becomes *D. s. bairdi,* while *Dryobates stricklandi* is replaced by *D. arizonæ.*

That "highly polymorphous Order," the MACROCHIRES (16th group), containing the Goatsuckers, Swifts, "etc.," presented in the 1886 List, *26 species* and *3 subspecies.* In the present vol-

ume (1895) it is seen to include *26 species* and *7 subspecies.* The following alterations, subtractions, and additions have been made in the interim. *Antrostomus vociferus arizonæ* becomes *A. v. macromystax.* The genus *Phalænoptilus* has two new subspecies, *P. n. nitidus* and *P. n. californicus. Chordeiles v. minor* becomes *C. v. chapmani,* and *Chordeiles texensis* becomes *C. acutipennis texensis.* The genus of Swifts formerly in *Micropus* are now in *Aëronautes.* We have but one species of it in this country—the White-throated Swift, which, known formerly as *Micropus melanoleucus,* now is written *Aëronautes melanoleucus.* Among the Hummingbirds we have the new species *Trochilus violajugulum, Trochilus costæ* is changed to *Calypte costæ,* and *T. anna* to *Calypte anna,* in other words, the subgenus CALYPTE has been raised to the rank of a genus. So likewise the subgenus SELASPHORUS has been similarly dealt with, and another species added to it, *viz.: Selasphorus floresii.* Also the subgenera STELLULA and CALOTHORAX become genera, each containing a single species. *Trochilus heloisa* has been omitted from the list, and *Basilinna leucotis* added to it.

Finally, we come to the last, or seventeenth group, that vast assemblage known as the PASSERES. It will not be as convenient to deal with these as the foregoing sixteen groups were dealt with, as many of the families contain more birds than several of the other "Orders" combined, so I shall resort to tabulating the comparisons, comparing family with family.

This comparison goes to show that in 1886 there were recorded 313 species of North American *Passeres,* and, in 1895, 321, giving a gain of 8 species for the nine years, while, for the same years and interval of time, there were 117 subspecies, and, in 1895, 185, showing a gain of 68 subspecies.

With respect to the *Cotingidæ,* the single species indicated in the above Table is Xantus's Becard (*Platypsaris albiventris*). Among the *Tyrannidæ* the following changes were made: (1) The new subspecies *Myiarchus cinerascens nuttingi* was added, and also (2) the subspecies *Contopus richardsonii peninsulæ;* (3) the species *Empidonax cineritius* is added, and (4) *Empidonax acadicus* becomes *E. virescens,* as does (5) *E. pusillus* become *E. trailli,* and (6) *E. trailli alnorum* (1895) has taken the place of

TABLE COMPARING THE PASSERES.

Families.	1886.		1895.		Remarks.
	Sp.	Subsp.	Sp.	Subsp.	
CLAMATORES.					
Cotingidæ			1		This family not in the 1886 list.
Tyrannidæ	29	7	32	9	
OSCINES.					
Alaudidæ	2	7	2	10	
Corvidæ	15	9	17	13	
Sturnidæ	1	0	1	0	(*Sturnus vulgaris*).
Icteridæ	19	7	19	8	
Fringillidæ	87	44	87	71	
Tanagridæ	5	1	6	1	(*Piranga rubiceps*).
Hirundinidæ	7	0	10	1	
Ampelidæ	3	0	3	0	
Laniidæ	2	1	2	2	(*L. l. gambeli*).
Vireonidæ	11	5	11	9	
Cœrebidæ	1	0	1	0	
Mniotiltidæ	57	9	57	13	
Motacillidæ	6	1	6	1	No changes.
Cinclidæ	1	0	1	0	No changes.
Troglodytidæ	24	7	24	16	
Certhiidæ	0	2	0	4	
Paridæ	19	9	20	15	
Sylviidæ	7	1	7	2	*Polioptila cærula obscura* added.
Turdidæ	15	7	14	10	
Total	313	117	321	185	

E. pusillus traillii; (7) *E. obscurus* (1886) becomes *E. wrightii*, and, finally, (8) *Empidonax griseus* appears as a new species.

In the family *Alaudidæ*, three new subspecies of "Horned Larks" are added to the List (*O. a. adusta*, *merrilli* and *pallida*).

In the family *Corvidæ* we have *Cyanocitta stelleri annectens* added as a subspecies, and *Aphelocoma cyanotis* as a species. In this genus occur also *A. californica hypoleuca*, *A. c. obscura* and *A. insularis*. A new subspecies of Raven is also recognized (*C. c. principalis*). Finally, and very properly, the generic name *Picicorvus* is replaced in the 1895 List by *Nucifraga* of Brisson.

Among the *Icteridæ* I note that *Dolichonyx o. albinucha* (1886) has been omitted, and that the genus *Callothrus* of Cassin has been adopted and made to contain *C. robustus*, which was formerly *Molothrus æneus* (1886). The subspecies *Agelaius phœniceus sonoriensis* and *A. p. bryanti* have been added.

The largest of all the passerine groups of birds is the family *Fringillidæ*. The following synopsis will show the changes that have been made in it since 1886:

SPECIES ADDED.

Junco ridgwayi.
Junco townsendi.
Melospiza insignis.
Euetheia canora.

SPECIES OMITTED.[1]

Carpodacus frontalis.
Zonotrichia intermedia.
Zonotrichia gambeli.
Sporophila morelleti.

SUBSPECIES ADDED.

Coccothraustes vespertinus[2] *montanus.*
Carpodacus mexicanus frontalis.
Carpodacus mexicanus ruberrimus.
Spinus tristis pallidus.
Plectrophenax nivalis townsendi.
Poocætes gramineus affinis.
Ammodramus henslowii occidentalis.
Ammodramus caudacutus subvirgatus.
Ammodramus maritimus peninsulæ.
Ammodramus maritimus sennetti.
Zonotrichia leucophrys intermedia.
Zonotrichia leucophrys gambeli.
Spizella pusilla arenacea.
Junco hyemalis shufeldti.
Junco hyemalis thurberi.
Junco hyemalis pinosus.
Junco hyemalis carolinensis.
Amphispiza belli cinerea.
Melospiza fasciata rivularis.
Melospiza fasciata graminea.
Melospiza fasciata clementæ.
Pipilo fuseus senicula.
Cardinalis c. canicaudus.
Pyrrhuloxia sinuata beckhami.
Pyrrhuloxia sinuata peninsulæ.
Guiraca cærulea eurhyncha.
Passerina versicolor pulchra.
Sporophila mocelleti sharpei.

SUBSPECIES OMITTED.

Carpodacus frontalis rhodocolpus.

[1] So long as the geographical range of a species is extended it makes not an iota's difference how that extension has been accomplished, whether it has been through human agency ("introduction"), or by other means, for when the bird becomes thoroughly established in sufficient numbers, and breeds, it is entitled to a place in any List presenting the ornis of the country into which it has come.

The Starling (*Sturnus vulgaris*) essentially gained a place and recognition, in the A. O. U. "List" from the fact that it has been successfully "introduced" from abroad. If this be granted, the Committee were guilty of very unscientific practice when they omitted the English Sparrow (*Passer domesticus*) from the "List," (also *Passer montanus*), and it can only stand as an example of how far men will allow their prejudices to carry them, and blind their scientific instincts.

[2] Spelled "*vespertina*" in 1886 edition.

Between the species *Carpodacus cassini* and the subspecies *Carpodacus mexicanus frontalis*, the subgenus Barrica is introduced.

Progne subis hesperia has been added to the Swallows (*Hirundinidæ*), as well as *Progne cryptoleuca*, and *Petrochelidon fulva* as a straggler. The Bahaman Swallow (*Callichelidon cyaneoviridis*) having accidentally occurred on the Dry Tortugas, it introduces both the species and genus to which it belongs.

To the *Vireonidæ* were added *V. s. alticola* and *V. s. lucasanus*, as well as *V. n. maynardi* and *V. huttoni obscurus*.

In the case of the family Cœrebidæ, the genus Certhiola is superseded by Cœreba, and consequently *Certhiola bahamensis* becomes *Cœreba bahamensis*.

But few changes are noticeable among the Mniotiltidæ, and these principally the addition of new subspecies. The Dusky Warbler (*Helminthophila celata sordida*) is one of these, *Dendroica æ. sonorana*, *Geothlypis trichas ignota* and *Geothlypis poliocephala ralphi* being the others.

To the family Troglodytidæ there are to be noted a number of additions and some few changes. They may be shown thus:

1886.		1895.
Harporhynchus longirostris	=	*H. l. sennetti.*
		Subsp. added.
		Harporhynchus cinereus mearnsi.
Genus Campylorhynchus	=	Genus Heleodytes.
C. brunneicapillus	=	*H. brunneicapillus.*
		Subsp. added.
		H. b. bryanti.
714. *C. affinis*	=	Omitted.
		Subsp. added.
		713 *b. H. b. affinis.*
		Catherpes mexicanus punctulatus.
		Thryothorus ludovicianus lomitensis.
		Species added.
		Thryothorus leucophrys.
Thryothorus brevicaudus	=	*T. brevicauda.*

	Subsp. added.
	Troglodytes ædon aztecus.
	Cistothorus palustris paludicola.
	Cistothorus palustris griseus.
	Sp. added.
	Cistothorus marianæ.

In the Certhiidæ, *Certhia familiaris mexicana* becomes *C. f. alticola*, and *C. f. montana* and *C. f. occidentalis* are added as new subspecies.

Among the Nuthatches and Tits (*Paridæ*) the following additions and changes are to be noted.

1886.		1895.
		Subsp. added.
		Sitta carolinensis atkinsi.
		Sitta pygmæa leuconucha.
		Parus bicolor texensis.
		Subgenus PARUS inserted.
		Parus carolinensis agilis.
		Parus hudsonicus stoneyi.
		Parus hudsonicus columbianus.
		Species added.
		Psaltriparus santaritæ.
[745] *P. mlanotis*	=	*Psaltriparus lloydi.*

Finally, among the family *Turdidæ*, we have:

1886.		1895.
Turdus f. salicicolus	=	*T. f. salicicola.*
Sialia mexicana	=	*S. m. occidentalis.*
		Subspecies added.
		Sialia mexicana bairdi.
		Sialia m. anabelæ.

I am now prepared to present some comparisons with respect to the numbers of species and subspecies in 1886 and 1895, and these may be best shown again by means of a Table, as follows:

TABLE.

Group.	Recorded in 1886.		Recorded in 1895.	
	Sp.	S. sp.	Sp.	S. sp.
Pygopodes	33	4	32	4
Longipennes	44	4	46	4
Tubinares	31	3	32	3
Steganopodes	17	5	19	5
Anseres	51	6	51	8
Odontoglossæ	1	0	1	0
Herodiones	19	2	20	3
Paludicolæ	17	3	21	1
Limicolæ	66	4	68	6
Gallinæ	22	18	21	22
Columbæ	12	0	11	4
Raptores	53	29	54	37
Psittaci	1	0	1	0
Coccyges	9	0	9	4
Pici	23	11	22	14
Macrochires	26	3	26	7
Passeres	313	117	321	185
Grand total	738	209	755	307

This table will go to show that taking the species and subspecies together in 1886, they amounted to 947, while in 1895 there were no less than 1062. In substracting the number of species recorded in 1886 from those in 1895, we find that there has been a gain of 17 species, and in dealing with the subspecies in the same manner, we find that there has been a gain of 98 subspecies. A study of this table is interesting in other ways, as the making of similar comparisons of any single group, or those groups exhibiting the greatest increase and the causes therefor; but all such data can be easily appreciated by the reader from what has been given above, and my space will not admit of enlarging upon it here.

For a moment we may now turn to the " Hypothetical Lists " of the two editions of the work I have under consideration. In 1886 there were 26 species and subspecies relegated to its hypothetical list, ranging from 1 to 5 for the families in which they occurred. In 1895, *Diomedea exulans* is seen to be added

to the number, while *Chen cærulescens* is considered to belong to our avifauna, and has therefore been added to the list of 1895. The Swallow-tailed Gull, given as *Creagrus furcatus* in 1886, is now *Xema furcata*, and *nine* examples of it are said to be known to science, instead of only *three*, as reported in 1886. *Numenius arquatus* and *Chordeiles v. sennetti* are also added to the hypothetical list of 1895, while *Buteo fuliginosus* is ignored entirely.

Coming at last to the " List of Fossil Birds of North America," we find that as compared with the existing species, a greater number has been added to those previously known than there has been to the list of living birds. In 1886 there were 46 species of fossil birds reported, while in 1895 there were 64 upon the record. No doubt there are others that should have been added to these, overlooked by the Committee, as, for example, the rail-like bird called *Crecoides osbornii* Shufeldt, from the Upper Cenozoic of the staked plains of Texas. Marsh increased the list of Cretaceous Birds by the addition of three species, and the Tertiary Birds by one species, while Shufeldt added no less than fourteen new species of fossil birds as belonging to this latter geological horizon.

To this list should also have been added those belonging to the " Recent Era," as, for example, *Plautus impennis*—the Great Auk—and *Camptolaimus labradorius*—the Pied Duck. Of the first named species there is an abundance of subfossil material in existence, and of the latter there are doubtless bones to be found in the dried skins of specimens in museums and elsewhere. Both birds are quite as extinct as is the famous Jurassic bird, the *Archæopteryx* of the Solenhofen States of Bavaria.

But the addition of new birds to the avifauna of any country is by no means all there is to ornithology. Nor does the science see its end when these new forms have been described, figured and printed in an official list. The importance of giving a new bird a name, recording its superficial characters, and defining its geographical distribution is not to be underrated, the more especially so as all this greatly helps those who are engaged with the science of their morphology, their taxonomy, and their present affinities and past origin. One of the chief

aims of ornithology is to establish the true relations of existing and extinct forms of birds to each other, and to other groups of animals that are either to be found living at the present time, or else have existed during past ages of the earth's history. In other words, the true classification of birds is to be sought for, and ornithology in this sees its most difficult problem and its final goal.

But the knowledge of the origin of this most perplexing group of vertebrates, their evolution, and our power to correctly classify them can only come to us in one way, and that is through a complete understanding of their structure, and a comprehension of the anatomy of those groups more or less nearly related to them. Other departments, however, can lend great assistance here, and the avian taxonomist can have much light thrown upon his arduous task through the revelations of researches in the fields of physiology, of geographical distribution, nidology, paleontology, and other biological sciences.

With these facts before us, it is with no little interest that the taxonomist scans the pages of the second edition of "The A. O. U. Check-List of North American Birds," with the view of ascertaining what evidences there may be in the direction of a better knowledge of the classification of our birds. There may have been some excuse for the numerous symptoms of the somewhat antiquated taxonomy that characterized the arrangement of North American birds in the 1886 edition of the A. O. U. Check-List, but not so this last one, provided we find that the earlier classification has been retained. For, be it known, in the meantime, that is, from 1886 to 1895, the avian morphologists had not been idle. There were very many useful suggestions in the admirable work done by Dr. Stejneger that appeared shortly before the 1886 edition was printed. This was followed, in 1888, by the superb volumes of Fürbringer, with one of the most elaborate classifications of birds the world has ever seen; Seebohm, of England, had done a great deal, while the present writer had published accounts of the osteology of nearly every family of N. American Birds, and Mr. Lucas stands prominent in his excellent anatomical work upon many of the groups. English pens had contributed memoir after

memoir along similar lines, and one has but to turn to the essays and volumes of Newton, Gadow, Beddard, T. J. Parker, Sharpe and many others to appreciate this. But for one to fully know what a deal was done during the nine years I speak of, it is but necessary to read the enthusiastic address of Fürbringer given before the Section for the Anatomy of Birds at the Second International Ornithological Congress, held at Budapesth in 1891. A powerful light has been thrown upon the structure and affinities of the various groups of birds, and has it in any way affected the classification of the 1895 Check-List of North Ameican Birds, that is, in so far as the main groups are concerned? Not in the least. Apart from the addition to the List of the family *Cotingidæ*, the taxonomy of the orders and families as given in 1886 are identical with the arrangement reproposed in 1895. For example, we still find the Grebes, Loons and Auks retained together in the Order PYGOPODES, with the first-named separated from the last two by subordinal lines; whereas, Fürbringer, Thompson, Sharpe, myself and others, all of whom have examined the structure of these birds, have shown the affinity existing between the Grebes and Loons, and that these two families are very distinct from the Auks. The Auks, in fact, occupy a group by themselves, and are more nearly related to the Longipennes. Fürbringer separated them very widely from the Grebes and Loons, in which opinion Sharpe and others concur. That the Longipennes and the Limicolæ are akin is now generally recognized by those who have studied the anatomical structure of the members of the two groups, yet in the A. O. U. classification, six entire Orders stand between the Gulls and the limicoline assemblage. Fürbringer makes a "Gens" Laro-Limicolæ, and Sharpe keeps the two groups close together. As long ago as 1867 Professor Huxley clearly showed the osteological agreement between the skull of a Plover and that of a Gull.

That the Fowls (*Gallinæ*), Pigeons (*Columbæ*), Raptorial Birds (*Accipitres*), Parrots (*Psittaci*) and the Cuckoos (*Coccyges*) as groups should stand in lineal series I can well believe—but as Gadow, Hubert Lyman Clark, myself and others have frequently pointed out, the Owls do not belong with the Acci-

pitres or the Falcons and their kin, while I make separate groups for the Cuckoos, Kingfishers and Trogons. The Woodpeckers are not separated from the Passeres by the Goatsuckers, Swifts, and Hummingbirds, as the A. O. U. List now have them arranged, but the Woodpeckers, in the list of North American Birds, taxonomically arrayed, should stand immediately next to the Passeres, while the "Macrochires" is a thoroughly unnatural group, inasmuch as birds are no longer classified and restricted to groups on account of their having long pinions.

Finally we come to the *Passeres* with the lineal arrangement of the 21 families composing the group. Now, as a classificatory scheme, this lineal method of showing it is unsatisfactory in the extreme, but it appears to be the only available one to adopt in the Lists in books. A "tree" shows what is meant much better and truer, but it can never form a part of a List. Still these Lists show something, for we can, among other things, indicate in them the families that should, in our opinions, occupy the extremes—as, for instance, the *Tyrannidæ* and the *Corvidæ*, but in numerous cases it will be found to be exceedingly difficult to complete the sequence, even to carry out the hopes of the classifier. However, marked violences can usually be avoided, and marked affinities often shown in a classification of this kind.

The scheme adapted in the A. O. U. Check-List, although not altogether a bad one, is capable of showing a more truthful arrangement of the families of passerine birds. In the first place, this List should be completely reversed; then the Thrushes (*Turdidæ*) placed more nearly where they belong; and the *Laniidæ* removed very much nearer the Clamatorial end of the sequence, and away from the Vireos, with which family they have no special affinity. Thus much for the progress in American ornithology during the past ten years; our ornis has been most carefully studied in so far as the identification of new species and subspecies is concerned, but the matter of scientific classification of birds demands increased attention, and it is to be hoped that a greater number of avian morphologists will arise, and should that come about, the clas-

sification of the next edition of the A. O. U. Check-List will, in truth, be archaic if again printed without change; the 1895 one, just out, is a number of years behind the science of the times, so we may easily imagine how very backward it will appear ten years hence.

THE PATH OF THE WATER CURRENT IN CUCUMBER PLANTS.

By Erwin F. Smith.

Although Sachs' notion that the ascending water current in plants passes through the walls of the vessels and not through their interior, was rendered very doubtful long ago, if not thoroughly exploded, by the experiments of Elfving, Vesque, Erera, Boehm and others, the old statement still remains in many of the text books and continues to be taught. For this reason, and because the papers of the opponents of this view do not seem to have received much attention in this country, while Dr. Sachs' *Lectures on the Physiology of Plants* in H. Marshall Ward's admirable translation, is known and read everywhere and deservedly so, it may be worth while to call attention once more to the present state of our knowledge on this subject. This I shall do by presenting some experiments of my own, which were made a year ago on *Cucumis sativus* L. These were undertaken partly to verify some of Strasburger's statements in his book *Ueber den Bau und die Verrichtungen der Leitungsbahnen in den Pflanzen,* and partly to determine, as accurately as possible, the path of the water current in Cucurbitaceous stems, subject to the attack of *Bacillus tracheiphilus.* They were begun about March 20, and continued till some time in April, the weather being by turns warm and cold, sunny, windy, cloudy and rainy. About 30 well grown cucumber vines were experimented upon, the following being selected as typical. All were under glass in a large hot-house, devoted to the cultivation of cucumbers for the winter market. None of the vines trailed on the ground, but all were trained up on

stakes or over high strung wires. A sharp razor was used in cutting the stems.

Before proceeding to the experiments, it will be necessary for the sake of those who are not familiar with the structure of the cucumber stem, to briefly indicate its anatomy. The bundles are bi-collateral, i. e., there is a group of phloem on the inner, as well as on the outer face of the bundle. The outer phloem is separated from the central strand of xylem by a cambium zone, which is restricted to the bundle, i. e., not inter-fascicular. The inner phloem is separated from the xylem, by a meristematic tissue structurally much like cambium, but functionally different. The phloem consists of numerous large sieve tubes, with the usual accompanying cells and cambiform cells. The central or xylem strand of the bundle consists principally of large pitted vessels, held together by shorter tracheids and lignified parenchyma. The mode of origin of the pitted vessels, i. e., out of a series of large superposed cells, is plainly visible, the cross septa being sometimes present and perfect, but more often partially wanting or reduced to mere rims on the inside of a continuous tube. The walls of these tubes contain thousands of very thin places, or actual perforations, (in many cases the central slit takes no stain), and the tubes appear to be admirably adapted for water reservoirs, any adjacent portion of the plant being clearly able to draw from them without hindrance. It appears to me somewhat doubtful, whether they also function as direct water carriers. This business seems more suited to the spiral vessels which occur in a little group on the inner face of the xylem strand, embedded in a delicate, non-lignified living parenchyma, which frequently contains chlorophyll. The walls of these spirals are not pitted; their bore is almost capillary, i. e., much less than that of the pitted vessels; and they are of great length, probably by means of splicings extending as open tubes the whole length of the vine. That they are of more fundamental importance to the plant than are the pitted vessels, appears from the fact, that they are the only tubular parts of the xylem to be found in the smaller roots, and are also the only xylem-vessels passing out of the stems into the peti-

oles and ramifying in the veins of the leaves. It seems to follow from this that whatever be the path of the water current in the stem itself, it can enter the body of the plant in quantities sufficient for transpiration purposes only along the pathway of the spirals, and can reach the leaves only through the same channels.

The pitted vessels are probably sometimes nearly full of water, and at other times nearly empty, the amount depending on the quantity in the soil and on the activity of transpiration. Owing to the number of very thin places or actual perforations in their walls, they undoubtedly contain air at all times and probably often in large quantities. I regard these vessels as water reservoirs. In this capacity they appear to be admirably adapted to serve the needs of a class of plants which (on account of the extent and unprotected nature of their transpiring surface) often make sudden and very large demands on the stem for water,—demands greater than can be met by the immediate activity of the roots. There is, however, nothing against the supposition that when they are not full of water, they may also serve as aerating organs, the stems being alive and chlorophyll-bearing clear to the center. The function of the spiral vessels, according to my conception, is quite different. They also contain a greater or lesser quantity of water, according to the activity of transpiration and the amount procurable from the soil or from the neighboring reservoirs (the pitted vessels), but unlike the pitted vessels, they are surrounded by a living, non-lignified, nonlacunose parenchyma, and there is no free access of air to their interior, but, on the contrary, so far as we can judge from the anatomical structure, this part of the plant has been developed with special reference to keeping it out. When the spirals are not full of water, they probably contain rarefied air. The very thin walls of these spiral vessels bear on their inner face lignified annular or spiral thickenings, which are probably of great service in strengthening the delicate walls, so that they may be strong enough to resist the collapsing tendency of the vacuum pull due to the osmotic pressure, and yet remain thin enough to readily allow water to filter into

them or out, as the case may be. Such, roughly sketched, is the nature of the bundle, the xylem part of which contains 5 or 6 spirals and from 12 to 15, or more pitted vessels. The cucumber stem, exclusive of the hypocotyle, usually contains 9 such bundles, the 5 larger ones forming an interrupted ring or cylinder in the central part of the stem, and the four smaller ones alternating with the larger ones nearer the surface of the stem, the fifth bundle of the outer series being usually wanting in this species. These bundles are separated from each other by thin-walled, living cells which are nearly iso-diametric. The central. portion of this parenchyma and that between the bundles, may be designated as medullary tissue, and that farther out as cortical parenchyma, although all of this fundamental tissue bears chlorophyll, and is used to store starch in prior to the development of the fruit. Outside of the bundles, and not far from the surface of the stem, is a compact tissue formed of numerous elongated, thick-walled, flexible, strengthening cells. These are the bast fibres, forming collectively, the stereomatic sheath. This sheath is several rows of cells thick and forms an broken or nearly unbroken cylinder in the young stem, but is afterwards ruptured longitudinally into a dozen or more strands by the growth of the stem in thickness. Between these strands of stereome, the cortical parenchyma finds its way to the epidermis, except where the latter is specially strengthened by sub-epidermal strands of collenchyma. The stem appears to have so developed as to secure every advantage to be derived from a combination of lightness with flexibility and strength.

To indicate the movement of the water in the stems and leaves, various aniline stains were tried, e. g., eosine, soluble nigrosene, methyl green, methyl orange, acid fuchsin, etc. Eosine proved by far the most satisfactory, none of the other stains moving with anything like the same rapidity, and some of them causing copious precipitates in the vessels. None of the substances in the sap of the cucumber vessels cause any precipitate with eosine, and it is probable that dilute solutions of this substance, while clearly poisonous to the plant, move with the same rapidity as pure water, at least at first.

1. Upward Movement of One Per Cent. Eosine Water Through Cut Stems.

(No. 9). This vine was 215 centimeters long and bore a number of small leaves and 17 large ones, 10 of which averaged 20 cm. in breadth. March 21, 2:30 p.m. The stem near the earth was cut under water and put at once into 1 per cent. eosine water.[1] 2:43 p.m. The stain is now distinct in all of the principal veins of a leaf only 15 cm. from the end of the stem, i. e., it has passed up the stem a distance of two meters in less than 13 minutes, probably in 10 to 12 minutes. 2:47 p. m. The red stain is now distinct in the veins of the small undeveloped uppermost leaves of the stem. 3:25 p. m. Slight droop of the foliage, but much less than in No. 10 (a similar vine in 10 per cent. eosine water). Foliage decidedly less red than that of No. 10. 4:35 p. m. Leaves drooping very decidedly. The leaves of No. 10 are flabbier and redder, but much less fluid has passed up the stem. 5:10 p.m. About 21 cc. of the eosine water has passed up the stem in 2 hours and 40 minutes. March 22, noon. Leaves, tendrils and surface of the young fruits reddish. The stain does not make its way readily into the coiled tips of the tendrils. Many of the leaves are dry shriveled, so that they crackle on touch. Stem not shriveled. Most of the petioles are still turgid and but little stain is visible in them, except in a few toward the top of the vine. 4:00 p.m. Not nearly so red as No. 10. Stem quite green and not noticeably shriveled. The stem of No. 10 in the 10 per cent. eosine has shriveled decidedly to-day. March 23, 12:25 p.m. About 10 cc. of the stain has passed up the stem since last night. 4:30 p.m. About 10 cc. of the stain has gone up the stem since the last record. March 25, 12:30 p.m. About 20 cc. of the stain has passed up the stem since the last record. Most of the leaves are crisp dry, but the terminal ones are still moist, although shriveled and soft like old rags, the parenchyma being yellow and the veins bright red. Most of the petioles are bright red, and all of them are limp and hang straight down; the stem has shriveled and become reddish, except the

[1]Distilled water containing Dr. Grübler's "Eosine Soluble in water."

submerged part, which has kept its turgor and resists diffuse staining better than the parts in the air. The plant is dead. March 26, 2:40 p. m. About 12 cc. of the eosine has passed up the stem since yesterday p. m.

In this plant over 40 cc. of the eosine water passed up the stem during the first 24 hours, and in the next four days an additional 45 cc., part of which after the plant was dead.

Vine No. 1 which was 188 centimeters long, also took up the eosine water after it was dead. This absorption of the stain continued long after the leaves had become dry-shriveled, and did not entirely cease until all parts of the bright red stem became bone-dry. This vine was under observation 14 days, during which time about 150 cc. of 1 per cent eosine water passed up the stem, only 57 cc. of which went up during the first 49½ hours.

(No. 25). This was a young vine, measuring 100 centimeters above the cut surface. It bore 17 leaves, the largest 6 averaging 13 cm. in breadth. March 28, 11:56 a. m. The stem was cut under water and put at once into an alkaline eosine water, made by putting 1 gr. eosine into 100 cc. of $\frac{N}{10}$ caustic soda (the solution stood in the laboratory over night and became darker colored). 12:01 p. m. The red stain is distinctly visible in the veins of all the leaves, even the uppermost ones, i. e., it has gone straight up a distance of one metre in 5 minutes. It is sunny and windy, and transpiration is active. The dry bulb registers 22° C.; the wet bulb 17.3° C. 12:10 p. m. The foliage begins to droop. 12:40 p. m. Foliage wilting very badly. 2:10 p. m. About 5 cc. of the stain have passed up the stem. The lower leaves have begun to crisp at the margin. March 29, 2:30 p. m. About 7 cc. of the stain have passed up the stem since the last record. The blades of the leaves are crisp and the petioles are bright red. March 30. Fluid quite dark ; an additional 4 to 5 cc. has gone up the stem. Stem and petioles much brighter red than yesterday. April 3, 11 a. m. The entire stem and all of the petioles have become extremely bright red, the eosine water (20 cc. of it) having continued to pass up the dead stem since the last record. The leaves appear to have taken up no stain since March 29.

They are not now crisp, but feel limp like old rags. The veins are bright red, but the parenchyma is yellowish-white. The surface of the stem feels moist and stains the fingers red when rubbed.

Similiar results were obtained with a 1 per cent. solution of sodium chloride containing 1 per cent. eosine. Acidulated waters (1 per cent. citric acid and 1 per cent. hydrochloric acid) also passed up the cut stems rapidly and in large quantity, and after the stems were dead. The 1 per cent. hydrochloric acid proved much more poisonous to the plant than did the 1 per cent. citric acid. Similar experiments were made with hydrant water. In the latter, after a few days, the plants reduced their foliage to a minimum, and then lived on for many days, i. e., in case of a plant used for comparison with No. 1, until long after the latter was dead and dry.

To sum up the results of these experiments, of which the preceding are only examples, we have the following propositions:

(1). The rate of movement of the water current in cucumber stems during active transpiration is at least 10 to 12 meters an hour. (2). Absorption of water and transpiration continues in dead stems for some time, i. e., until they have become dry. (3). Large quantities of fluid passed through the cut stems during the first few days. (4). When the cut stems were plunged into water tinged with eosine, sufficient of this stain was taken up to color all the tissues of the plant bright red, including parenchyma, sclerenchyma, collenchyma and epidermis; the first parts to show the stain being the spiral vessels.

(*To be Continued.*)

ON THE MISSISSIPPI VALLEY UNIONIDÆ FOUND IN THE ST. LAWRENCE AND ATLANTIC DRAINAGE AREAS.

By Chas. T. Simpson.

The entire Mississippi drainage area is peopled by a peculiar Unione Fauna.[1]

The species are exceedingly numerous. and many of them attain great size, or become very solid at maturity. A large number are characterized by strong sculpture in the form of knobes, pustules or plications, or by striking outlines, and the species in general are more richly colored externally or internally than those of any other part of the globe.

The Atlantic drainage area, including a considerable part of the St. Lawrence River system, is occupied by a very different Naiad fauna. As a rule the species are moderate in size and conform nearly to the ordinary oval or oblong-oval Unione type; they are of light structure, without sculpture or strong angularities and lobes, and are plain colored in nacre and epidermis.

The dividing line between these two Unione faunas is not directly on the Height of Land, which separates the St. Lawrence and some of the other Atlantic drainage systems from that of the Mississippi, but it is considerably to the northward and north-eastward of it.[2]

To the westward the Red River of the north, the Saskatchewan and Mackenzie are largely inhabited by Mississippi Valley Uniones, and they are found abundantly in all the great lakes, the southern peninsula of Michigan, the streams in Wisconsin, Indiana and Ohio that drain into these lakes, and well up into Eastern Canada, Lake Champlain and

[1] See paper by the writer "On the Relationships and Distribution of the North American *Unionidæ*" in Am. Naturalist, *XXVII*, p, 353.

[2] This matter will be discussed in a paper by the writer, which will soon be published in the Proc. N. S. National Museum "On the Classification and Distribution of the Naiades,"

the Hudson River, in some places mingling with the forms belonging to the Atlantic drainage area proper, in others occupying the waters exclusively.

I think we may safely take it for granted that the only way in which the Mississippi Valley *Unionidæ* could have entered these northern and north-eastern river systems was by migrating along connecting fresh water. As there is no such connection to-day between these systems the question as to how they reached their present distribution becomes an extremely interesting one.

If the theory of the Ice Age as held by most glacialists is a true one I think it will fully explain the present remarkable distribution of these extra-limital Mississippi Valley Naiades. And at the same time I believe the evidence of these fresh water mussels is strongly corroborative of the glacial theory. It is held that at the close of the Ice Age a great cap of ice of immense thickness covered North America east of the Rocky Mountains, down to about Latitude 40°. That with the coming on of warm weather it gradually melted away at its southern extremity, and that when this thawing was continued north of the height of land great lakes were formed whose southern shores were the slope of the land which raised towards the south, and whose northern borders were the slowly dissolving wall of ice. On account of the ice to the northward this water could only drain into the Mississippi system, or to the Southeastward, and several old channels are found through which it is believed that it flowed. One of these is the Red River of the North, which almost connects by means of Traverse Lake at its head with Big Stone Lake at the head of the Minnesota River. There is still a broad channel near the western end of Lake Superior which connects with the St. Croix River, and at Chicago there was no doubt an overflow from Lake Michigan into the Des Plaines River, and Lake Erie is believed to have had its outlet into the Wabash through the Maumee which nearly connects with it. The two streams are connected over a very flat country by an old channel not less than a mile and a half wide, and having an average depth of 20 feet. For 25 miles this character continues, and there is

very little fall either way. To the northeast this channel opens out into an ancient lake, and at the southwest it touches bed rock at Huntington, and then descends more rapidly.[3]

It will be noticed on the map that the St. Josephs, St. Mary's, and Auglaize Rivers, tributaries of the Maumee, flow in the direction of the Wabash, that the two former join at Fort Wayne and flow partly backward as the Maumee; the whole looking like a tree with its branches broken down, and hanging against its trunk. If the river was continued into the Wabash, and the water all flowed to the southwest it would form a natural looking system. It is quite within the bounds of probability that there were old overflows from the St. Lawrence drainage to the eastward of this through the Oswego River into the Mohawk, or by way of the Sorel into the Hudson, and possibly through eastern Lake Erie into the Alleghany system.

Now if the water from this region north of the Height of Land flowed over into the Mississippi drainage area at various places it would be almost certain that the *Unionidæ* of this system would migrate up these overflows and into the northern lakes, that in this region they would obtain a foothold and flourish, for the reason that at the time of their entrance it is quite probable that all freshwater life of this area was destroyed by the grinding and crushing of the great ice cap. It is possible that a few of the Naiades of the eastern drainage system might have survived in the St. Lawrence Valley but it is more likely that such as are now found there have since reached that region by migration from the overflows through the Mohawk and Oswego Rivers, or the Sorel. There has probably been at some time since the close of the Glacial Epoch a connection between the Hudson River and Lake Champlain, as the latter is largely peopled with Mississippi Valley *Naiades*. These forms, most likely, entered Lake Erie through the old Maumee Channel, or by some connection with the Upper Ohio system, passed into Lake Ontario, thence through the Oswego

[3] See a paper "On the Ancient Outlet of Lake Michigan," by Prof., W. M. Davis. Pop. Science Monthly, XLVI, No. 2, p. 217. Also a paper on this old system by G. K. Gilbert, in the first volume of the Ohio Geological Survey.

and Mohawk Rivers into the Hudson, and across into Lake Champlain; or they may have gone down the St. Lawrence and up the Sorel. If by a subsidence since that time Lake Champlain has been connected with the ocean, as is now believed, the Naiads of that lake no doubt retreated up the small streams flowing into it, and returned after the elevation of the land when its waters again became fresh.

I think I am not making too sweeping an assertion when I say that all the Mississippi Valley species of Naiades that have entered the St. Lawrence, or in fact any part of the Atlantic drainage areas, have become changed in some of their characters. As a rule, though not in every case, they have become smaller, and simpler in their outlines; the sculpture is less pronounced or is almost obliterated; in many cases the shells are thinner, the nacre has lost its brilliancy, and instead of the bright epidermis, often painted beautifully with rays or a wonderful pattern of rich greens, yellows, and olives we have mostly dull, livid, ashy or rusty reddish or brownish exteriors, and they are very often somewhat distorted. This is not, as I believe, in any great measure due to climate or colder water, for these same species are as vigorous and finely developed in parts of Wisconsin drained into the Mississippi, Minnesota and Dakota as in any part of their area; besides *Anodonta edentula* under the name of *A. undulata*, and *Unio* (*Margaritana*) *marginata* when found in Maryland, Virginia, and probably even south of that are so dwarfed and stunted as to be scarcely recognizable. This changing of characters has been well illustrated in a lot of *Unionidæ* recently submitted to me for examination by Prof. B. W. Everman of the U. S. Fish Commission, which was collected mostly from the Maumee basin by Dr. Philip H. Kirsch, of Columbia City, Indiana. This region lies in Lat. 41° to 41½°, the most southerly part of the St. Lawrence drainage. *Unio. luteolus* Lam., *U. subrostratus* Say, *U. circulus* Lea, *U. phaseolus* Hild., *U. multiplicatus* Lea, *U. multiradiatus* Lea, and *Anodonta grandis* Say, are so dwarfed and stunted, and changed in color as to be scarcely recognizable, while the same species from the Wabash, from which these have no doubt all been derived, are as vigorous and finely developed as any in the Mississippi Valley.

This great change in size, form and coloring has caused students to bestow many specific names on what I believe are merely northern races or varieties of common Mississippi Valley species. Thus Anthony's *Anodonta subangulata* and Lea's, *A. footiana, A. marryattana* and *A. benedictii* are merely dwarfed and slightly changed forms of Say's, *A. grandis.* Anthony's *A. subinflata* is probably a form of *A. corpulenta* Cooper, and *A. subcylindracea* Lea, is the northern manifestation of Lea's well known *A. ferussaciana.* Say's *Anodonta edentula* becomes in Michigan *Alasmodonta rhombica* of *Anthony,* and further east and southeast *A. undulata* of Say; Lea's *Unio circulus* of the central Mississippi area changes in Lake Erie to the dwarf *U. leibi* of the same author; his *U. canadensis* is only an altered over *U. ventricosus* of the western States, and A. Gray's *U. borealis* is a very much changed form of the common *U. luteolus,* while *U. hippopæus* Lea, of Lake Erie is, I believe, only a stunted *U. plicatus* that has almost entirely lost its plications, and has assumed a dirty, reddish or olive color.

Some of these are possibly valid species; most of them would certainly be considered so, together with a number of other northern manifestations of Mississippi Valley species were it not that so many intermediate links are found.

It sometimes happens that specimens of a given species are found in the Mississippi area, growing, no doubt, under unfavorable conditions, that so closely imitate the same species found in northern waters as to be indistinguishable from it. Thus Lea has in his collection what he called *Anodonta footiana,* a Michigan form, from Illinois, and depauperate *Unio plicatus* are sometimes found in the Mississippi area that are almost exactly like *U. hippopæus.* And on the other hand occasionally fine specimens of *Unio rectus, U. rubiginosus, Anodonta ferussaciana* and *A. grandis* are found in the St. Lawrence drainage that are perfectly normal. Yet as a rule an expert can tell at a glance whether a specimen grew in the Mississippi area or was extra-limital.

Anodonta simpsoniana Lea, is, I believe, a good species, although it is probably an altered and dwarfed *A. grandis.*

It is possible that here we have an opportunity to make some kind of an estimate as to the time required in developing species and varieties among the *Unionidæ.* It is well known that the Laramie strata of the northwest, belonging perhaps to the upper cretaceous or earlier Tertiary systems contain the remains of a large number of Unios which appear to be very closely related to existing Mississippi Valley forms, and are probably their progenitors. Some of these old fossils are so much like certain recent species that they might easily be taken for them by an expert, and nearly or quite all of them can be placed in existing groups.

Yet it is more than probable that the great variety of changes that have been produced in the Mississippi Valley forms which now inhabit the St. Lawrence drainage area have taken place since the Ice Age began to draw to a close, because it is almost certain that all fluviatile and lacustine life under the ice sheet was destroyed, and that any forms closely allied to those of the Mississippi Valley now found north of the Height of Land migrated there since. It is held by most glaciologists, I believe, that the Glacial Epoch reached down probably to within from 10,000 to 20,000 years of the present. This amount of time might probably be taken as the age of these peculiar forms of St. Lawrence Mississippi Naiades.

Unio radiatus, ochraceus, cariosus, heterodon, tappanianus, and *Margaritana undulata,* which are found in the Atlantic drainage south of the line of the ice cap, and which are all closely related to common Mississippi Valley forms are probably older, and may have been derived from some migration made from the western to the eastern drainage at a much earlier date. At any rate I believe that all the Uniones which belong properly in the Atlantic drainage system were derived at one time and another from Mississippi Valley species; that some peculiarity of environment common to this entire region has had a tendency to dwarf them, to simplify their forms and dull their colors.

EDITOR'S TABLE.

Naturalists need not feel unkindly just now towards representative Dingley of Maine, who introduced a bill for the destruction of the seal herd of Behring Sea, which has passed the lower house of Congress. From the point of view of the lover of nature this bill appears to be an atrocity, but everything does not appear on the surface. The sole object is to destroy the commercial value of the herd, so as to put a stop to the slaughter by reckless Canadian poachers. A sufficient number will be preserved to serve as a basis of a new herd, whenever the British and Canadian Governments are ready to join hands with us in the effort to preserve it. The Dingley bill is really a plan for preserving the herd and not destroying it. The fact is that our neighbors across the border have been running up a bill of small accounts against themselves, which will in the aggregate prove burdensome to them some day if continued. It is poor policy for a weak party to make itself unpleasant, especially when the stronger party is desirous of friendly relations. Canadians and Americans are really one people, and we ought to combine not only to protect the seals, but to increase theirs numbers, and develop the industry which depends on them.

Some naturalists think it is quite the proper thing to protest that it is of absolutely no importance whether they receive credit for a discovery or not, and it is more than intimated in print from various quarters from time to time, that interest in such questions is quite inconsistent with the lofty aims of science. We must confess to having become somewhat weary of this alleged elevation of sentiment, for we find human nature to be in scientific investigators not so very different from that which is common to the rest of mankind. Under the circumstances these protestations savor of cant. The naturalist like other men must live. In order to live he must be known; hence necessity forbids that he hide his light if he have any, under a bushel. And in fact the majority of naturalists do not do so. They understand the value of honest advertising. The product of a laborer should be labelled, first for his own advantage, and second for the information of others, who know his personal equation. What we want is honest goods with honest labels, and for these no protestations of pseudomodesty, or depreciation on the part of unpractical idealists, is in place.

We are pleased to notice the excellent scientific work which is being done by the Field Museum of Chicago. The management has called

to its aid a number of able scientific men, and is publishing the result of their work in suitable style. The papers of Hay on the Vertebral Column of Amia, and the skeleton of Protostega, are important contributions to knowledge. We hope soon to give an abstract of the illustrated paper of Holmes on the Yucatan ruins. It seems that the Museum is not to be merely a show place, but is to be a center of original research, worthy of the great city in which it is sitnated.

Perhaps a year ago we objected in rather caustic terms to the proposed publication by the Filson Club of Louisville, Kentucky, of the life and bibliography of Rafinesque. We are at the time under the impression that the club was a scientific body, and we were then of the opinion, as we are now, that such a society might easily find better use for its money than the publication of such a work. The fact is, however, that the object of the society is the preservation of historic records, and not of the results of scientific research. Hence the publication in question was precisely within its scope, and Prof. Call, the author, conferred a benefit on us all in writing the book. The history is a very curious one, and will interest even the non-scientific reader. Manuscripts in the possession of the U. S. National Museum show that Rafinesque had a skillful pencil, and that the figures which accompany his printed works do him injustice.

President Cleveland deserves well of his fellow countrymen for various reasons, but he deserves least, of his scientific constituency. His latest appointment, that of the U. S. Commissioner of Fish and Fisheries, was made in spite of different recommendations of the scientific men of the country, and for reasons which are to this class quite inscrutable. The new appointee was, as we are informed, retired from the navy on account of rheumatism. He has no scientific knowledge or experience of the habits of fishes or the conduct of fisheries, and would seem to be physically incapacitated from learning. Doubtless the President has told him as the old lady told her daughter who asked her if she might go in to swim; father may I the fishes save from thoughtless cruel slaughter? yes, yes my son, save every one, but don't go near the water.

RECENT LITERATURE.

Geological Survey of New Jersey.[1]—The Annual Report of the State Geologist for the year 1894 contains an account of the progress made in the study of the surface geology, by R. D. Salisbury; a report on the artesian wells in southern New Jersey, by L. Woolman, and a statement of the results of the surveys made with reference to ascertaining the forest area of the state, by C. C. Vermeule.

Mr. Salisbury makes an especial point of the influence that "stagnant ice" has had upon the deposition of the stratified drift of the valleys of the northern part of the state. In his description of Flat Brook Valley he remarks that "the form of topography characteristic of this valley, and of stagnant ice deposits in general, is the following: A broad and somewhat swampy flood plain in the axis of the valley is bordered on one or both sides by a strongly-marked kame belt a few rods in width. This kame belt is lowest near the axis of the valley. It rises in the opposite direction, and finally grades into a flat-topped terrace." These terrace differ from normal river terraces primarily in the fact that the slopes which face the axis of the valley are not erosion slopes.

Mr. Woolman's report confirms the conclusions of former observations, that the principal water-bearing horizons are found in Cretaceous strata.

The forestry report includes a paper on the forest conditions of south Jersey, by John Gifford. The interest of this paper centers in the practical suggestions it contains as to the treatment of forest lands, both for their preservation, and for pecuniary return for money and labor spent in their care. The paragraphs on Forest Influences, and Forest Economics should, in the interest of the people, be quoted in every local paper of the State.

Nine page-plates are used for illustrations, and a geological map of the valley of the Passaic—topographic sheet 6 in envelope, accompanies the Report.

Annual Report, Vol. VI, Geological Survey of Canada.[2]—This volume comprises the summary reports on the operations of the

[1] Annual Report of the State Geologist of New Jersey for the year 1894. Trenton, N. J. 1895.

[2] Annual Report (new series) Geological Survey of Canada, Vol. VI., 1892-93. Ottawa, 1895; Dr. H. R. C. Selwyn, Director.

survey for the years 1892 and 93, by the Director; reports on the Geological investigations conducted in central Ontario and southwestern Nova Scotia by F. D. Addens and L. W. Bailey respectively; a contribution to the knowledge of the minerals of Canada, as shown by chemical analyses, by G. C. Hoffman; and a report on mineral statistics and mines, by E. D. Ingall and H. P. H. Brumell.

The Director's report includes much valuable information concerning the hitherto practically unexplored regions of the Labrador peninsula, and the western coast of Hudson's Bay.

Sketch maps of southern Keewatin, and of the south-western part of Nova Scotia accompany the reports on those regions, and a number of statistical diagrams show the progress of the mining indutries.

Elementary Physical Geography.[3]—A new text book of physical geography has been long needed, so that this work of Mr. Tarr's is well timed. The author divides the subject into three parts the Air, the Ocean, the Land, giving the physiographic side more prominence than is customary in works of this kind. The language is clear, the illustration apt, and the information up to date. Each chapter is supplemented by a list of reference books and an appendix contains descriptions of meteorological instruments, apparatus and methods of use, suggestions to teachers, and questions upon the text.

The text is usually well illustrated with diagrams and reproductions of photographs many of them new, while the addition of 29 plates and charts completes a most attractive volume. We can recommend it for use as the best text book for colleges before the public.

Guide Zoologique.[4]—A reference book, published for use during the meeting of the International Congress of Zoology at Leyden in 1895. Brief accounts are given of the zoological courses offered in the various schools of Holland, also of the Zoological institutions, gardens, and societies. The fauna of the country is summarized by specialists, the history of the domestic animals revewed, and a short account of the fishing industry closes the zoological part of the volume. The final chapter is devoted to the climate of Holland.

The many maps and plates which are distributed through the book, its convenient size, and the clear, concise language of the text, combine to make an admirable guide book,

[3] Elementary Physical Geography. By R. S. Tarr. New York and London, 1895. Macmillan & Co.

[4] Guide Zoologique. Communications diverses sur les Pays Bas. Leyde, Septembre, 1895.

Marshall and Hurst's Practical Zoology.[5]—The fourth edition of this work being called for, the work of revising and editing it has devolved upon Mr. Hurst, to bring the work up to date numerous changes have been made, the most important of which, perhaps, are in the chapter on Amphioxus.

The work as originally written was intended to give the junior students of Owens College, Manchester, England, a practical acquaintance with animal morphology, and the present revised edition will be found a useful laboratory text book for any one who wishes to acquire an insight into the leading facts of Animal structure, and a technical knowledge of the principal methods of research.

The illustrations are intentionally few, as it is expected that the student will make drawings from his own dissections. These are, however, of excellent quality.

Works of this class are of utility in the laboratory, but they do not take the place of general text books as guides to the larger problems of zoology.

Elementary Lessons in Zoology.[6]—In the hands of a competent teacher this book will be of value in giving a student a fair start in the study of zoology. It is in reality a Laboratory Manual. Four simple types of animal structure are given to familiarize the student with the meaning of the terms, *cell, protoplasm, tissue, differentiation sexuality,* etc. Considerable attention is given to insects; then follow in turn common forms of Crustaceans, Worms, Molluscs and Vertebrates. The study of the animal alive, and in its biological relation to its environment, is made a prominent feature. To this end methods of observation are given with suggestions as to the facts to be ascertained. In this way the student acquires a practical knowledge of the life histories of the animals studied.

An appendix contains directions for the preparation of material for study.

The illustrations are intended as guides to identification, and in a very general way, they answer the purpose.

Chats about British Birds.[7]—The depiction of bird life in this volume is quite a vivid and interesting as was that of insect life, by

[5] A Junior Course in Practical Zoology. By A. Milnes Marshall and C. Herbert Hurst. Fourth Edition revised by Mr. Hurst. New York, 1895. G. P. Putnam's Sons.

[6] Elementary Lessons in Zoology. By James G. Needham. New York, 1895. American Book Co.

[7] Chats about British Birds. By J. W. Tuft, London, Geo. Gill & Sons.

the same author, in *Rambles in Alpine Valleys.* Members of thirty three families are described in an easy, gossipy fashion, with special reference to their food and nesting-habits. No opportunity is lost for pointing out that in general, birds are the farmers best agents for protecting crops from insects and worms. The fruit eating proclivities of the Thrush and the Black bird in the late summer are excused for the wholesale destruction in early spring of insects, worms, slugs and snails.

The book is intended to interest young people in the study of Ornithology, but from the facts set forth, it may also be of use in creating among farmers a better appreciation of the service rendered them by birds, and lead them to see the necessity of organized protection for the feathered race.

Check List of North American Birds.[8]—The American Ornithologist's Union have issued a second edition of the Check-list published in 1885. The new addition includes the numerous additions and nomenclature changes made in the several supplements to the Check List since the publication of the original edition, together with a revision of the "habitats" of the species and subspecies, but omitting the Code of Nomenclature.

Species whose status as North American birds is doubtful are listed separately under the heading "Hypothetical," and the fossil birds are likewise separately classified.

As an authoritative nomenclator this book has much value, but it could be rendered more authoritative if the A. O. U. would insist on correct orthography in all cases where this is ascertainable. In several instances the list adheres to obvious misspelling and typographical errors; such as hasitata for hæsitata; cincinatus for cincinnatus; Leptatila for Leptoptila; Ammodramus for Ammodromus, etc.; Greek spellings instead of Latin are retained wherever the original authors used them, and some bad examples of the *vox hybrida* are perpetuated.

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[8] The A. O. U. List of North American Birds. Second Edition. New York, 1895.

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General Notes.

PETROGRAPHY.[1]

Ancient Volcanics in Michigan.—In an area in Michigan covered by Townships 42 to 47 N. and Ranges 30 to 34 West, is a succession of granites and gneisses overlain by a thickness of some 3000 feet of volcanic rocks, embracing acid and basic flows and tuffs. Among the basic rocks Clements[2] finds porphyrites and melaphyres, and among the acid ones quartz-porphyries and devitrified rhyolites. The melaphyres and porphyries are described under the names apo-basalts and apo-andesites, because they are altered forms of basalts and andesites. Some of the andesites are amygdaloidal, and nearly all show the effects of pressure. Andesitic and basaltic tuffs are both present. They exhibit no special peculiarities. The quartz porphyries among the acid flows are notable for the existence in them of corroded phenocrysts of quartz in which there has been developed a well marked rhombohedral cleavage. The groundmass of these rocks is sometimes micro-granitic and at other times is micro-poicilitic. The latter structure is peculiar in that it is produced by a reticulating net work of uniformly oriented quartz, between the meshes of which are irregularly shaped areas of orthoclase. The other acid lavas and the acid tuffs are similar to corresponding rocks elsewhere. The series is interesting as affording another illustration of a typical volcanic series of Pre-Cambrian age. It is one of the oldest accumulations of volcanic debris and lavas thus far described.

Gneisses of Essex Co., N. Y.—In a recent bulletin on the geology of Moriah and Westport Townships, Essex Co., N. Y., Kemp[3] gives a general account of the petrography of the gneisses, limestones, black schists, gabbros, anorthosites and dyke rocks of these regions. Most of these rocks have already been described in more detail in other papers. The gneisses are of several varieties. The most common is a member of the basement complex underlying the other rocks of the district. It is a biotite gneiss composed of quartz, micro-perthite, orthoclase, plagioclase and brown biotite, all of which minerals exhibit evidences of dynamic metamorphism. Near iron ore bodies the gneiss becomes more basic, abundant green or black hornblende, green

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Journal of Geology, Vol. III, p. 801.

[3] Bull. N. Y. State Mus., Vol. 3, No. 14, 1895, p. 325.

augite and a large quantity of plagioclase taking the places of the usual gneissic constituents.

Volcanic Rocks in Maine.—In a preliminary notice on the rocks of the Flox Islands, Maine, G. O. Smith[4] gives a brief account of the association of lavas and breccias on North Haven and Vinal Haven Islands. On North Haven the series consists of beds of porphyrites and of coarse volcanic breccias and conglomerates, layers of tuffs and sheets of quartz-porphyry. The porphyrites are sometimes olivinitic. The conglomerates and breccias are composed of fragments of the porphyrites cemented by a porphyritic matrix. The quartz-porphyry possesses no unusual features. On Vinal Haven the rocks are predominantly acid, comprising many banded and spherulitic felsites that were originally glassy rocks. The spherulites are felsitic or fibrous and are certainly original structures, since transitions from the felsitic into brecciated rocks may be traced, in the latter of which occur spherulites that were formed prior to the brecciation. The acid layers of the series are younger than the basic beds.

Spotted Quartzites, S. Dakota.—The Sioux quartzites in Minnehaha Co., S. Dakota, grade upward into variously colored quartz slates that are composed of quartz grains, iron oxides and mica in an argillaceous matrix that has crystallized in part as sericite, kaolin and chlorite. Many of the slates are marked by spots that are lighter than the body of the rocks. These spots are essentially of the same composition as the groundmass in which they lie, except that they contain less iron oxide. Their lighter color is due to bleaching out of the iron salt through the acid, probably of decomposing organic matter.[5]

The Gneisses and 'Leopard Rock' of Ontario.—The gneisses interstratified with the limestones in the Grenville series, north of Ottawa, Canada, vary much in character.[6] The predominant variety is a granitoid aggregate of reddish orthoclase and grayish-white quartz, a little or no mica, and sometimes garnets. Its bedding is very obscure. When the mica is abundant in the rock foliation is distinct. One variety of the rock is called by Gordon syenite-gneiss. It includes the 'leopard rock' of the Canadian geologists. The rock occurs as dykes cutting quartzites and pyroxenites. All the phases of the gneisses show the effects of pressure. The 'leopard rock' consists of

[4] Johns Hopkins Univ. Circulars, No. 121, p. 12.
[5] Beyer: Ib., No. 121, p. 10.
[6] Bull. Geol. Soc. Amer., Vol. 7, p. 95.

ellipsoidal or ovoid masses of feldspar and a little quartz, separated from each other by narrow anastomosing partitions of green interstitial substance composed of pyroxene and feldspar. When the ellipsoids are flattened by foliation the rock becomes a streaked gneiss. Under the microscope, in sections of the coarse grained gneisses, large crystals of pyroxene, microcline and quartz are seen to be imbedded in a fine grained aggregate of microcline and quartz. In the ellipsoidal varieties the ellipsoids are composed mainly of microcline grains and the interstitial mass is a fine grained mosaic of feldspar, quartz and augite. In the streaked gneiss the augite is partially changed to green hornblende, while crystalloids of idiomorphic hornblende indicates that some of this component is an original crystallization. The rocks are evidently sheared pyroxene-syenites. The author discusses the use of the term 'gneiss' and suggests that the term 'gneissoid' be restricted to the description of foliated eruptive rocks whose structure is due to magma motions, that 'gneiss' be used as a suffix to the name of any rock that has assumed the typical gneissic structure since its original consolidation, as diorite gneiss, etc., and that the ending 'ic' be used with reference to the mineralogic composition of a foliated rock whose origin is unknown—a dioritic gneiss, in this sense indicates a folaited rock whose present composition is that of a diorite.

Petrographical Notes.—In thin sections of sandstone inclusions that have been melted by basalts, Rinne[7] finds the remains of quartz grains surrounded by rims of monoclinic augite, cordierite, spinel, etc. In some of the glasses formed by the melting of the sandstone are trichites and crystallites of orthorhombic pyroxene. While this substance is found abundantly as a contact mineral in the sandstones enclosed in the basalts of Sababurg, the Blauen Kuppe and Steinberg, the author nevertheless regards it as a comparatively rare product of the contact action between these two rocks.

Bauer[8] declares that the rubies, sapphires, spinels and other gem minerals from northern Burma occur in a metamorphosed limestone on its contact with an eruptive rock whose nature is not known.

Penfield[9] obtains a heavy solution for the separation of mineral powders whose densities range between 4.6 and 4.94 by melting together silver and thallium nitrates in different proportions. The molten mass

[7] Neues Jahrb. f. Min., etc., 1895, II, p. 229.

[8] Sitzb. d. Ges. z. Beförd der gesamnet Naturw. Marburg, 1896, No. 1.

[9] Amer. Journ. Sci., Dec., 1895, p. 446.

attacks sulphides, but otherwise is of much value in separating mixtures of heavy minerals.

La Touche[10] describes an apparatus to be used in connection with diffusive columns of methylene iodide for the purpose of determining the density of minute fragments of minerals.

GEOLOGY AND PALEONTOLOGY.

Geology of the French Congo.—The Congo region belonging to France is greater in extent than the parent country. Through the enterprise of different explorers and the researches of scientific men, notably geologists and paleontologists, much information concerning this great tract of country has been acquired since 1871. M. Barrat has systematized the facts on record and publishes an interesting paper under the title "Geology of the French Congo," in which he embodies also the results of his own explorations in the valley of the Ogoove.

The observations of M. Pouel, made during a stay of many years in the region under discussion, confirm the conclusions of M. Barrat as to the great stratigraphic uniformity of the Congo. Furthermore, the formation of the basin after the uplift of the African plateau is explained by the progressive draining of a series of reservoirs, more or less depressed, placed at different altitudes and discharging from one to another toward the ocean. The limits of these reservoirs are in relation to the ancient rock ridges now hidden beneath the sandstone but occasionally laid bare by erosion.

Around the border of the basin, the formations plainly demonstrate that they were elevated as early as the carboniferous epoch, and although greatly leveled since, still show the primary reliefs. One of the most interesting is the formation of Adamaona; its substratum is granitic and metamorphic like the Crystal Mountains and the Mouamba Mountains and the region of Katanga, and there are also rocks which are similar to the Devonian of the Lower Congo. The whole formation has been intersected and to a great extent covered by erupted material, probably Cenozoic, and by outflows from volcanoes of undoubtedly much more recent age.

The structure of the plateaus of Adamaona is somewhat analogous to that of the central plateau of France. (Extr. Ann. des Mines liv. d'Aril, 1895.)

[10] Nature, Jan., 1896, p. 198.

Geology of the Nile Valley.—In a paper on the geology of the Nile Valley, Prof. E. Hull calls attention to the two great periods of erosion in this region, the first during the Miocene period, after the elevation of the Libyan region at the close of Eocene times, and the second during a "pluvial" period extending from late Pliocene times into and including the Plistocene. In the second part of the paper the terraces of the Nile Valley are described and full details given of the characters of a second terrace, at a height varying from 50 to 100 feet above the lower one, which is flooded at the present day. This second terrace is traceable at intervals for a distance of between 600 and 700 miles above Cairo. Two old river channels are also described, one at Kom Ombo and the other at Assuan itself. The author discusses the mode of origin of the second terrace and the old river valleys, and believes them to be due to the former greater volume of the river and not to the subsequent erosion of the valley. He gives further evidence of the existence of meteorological conditions sufficient to give rise to a "plnvial" period, and points out that other authors have also considered that the volume of the Nile was greater in former times. (Nature, March, 1896.)

The Antarctic Continent.—Mr. C. Hedley has published the data to date concerning the forms of life held as common stock by the converging land masses of the southern continent, together with the conclusions reached by several naturalists as to a former antarctic land area and the continuity of the southern land masses. The author states that the evidence collected tends to show Antarctica as an unstable area, at one time dissolving into an archipelago, at another resolving itself into a continent. From the distribution of the pond snail Gundlachia, he argues a narrow land connection during Mesozoic time between Tasmania and Terra del Fuego across the south pole, and that New Zealand at that time reached sufficiently near to this Antarctic land to receive by flight or drift many plants and animals (Proceeds. Roy. Soc. N. S. Wales, 1895).

Two Epochs in Vegetable Paleontology.—A late number of Science contains a tribute by Lester Ward to the memory of two eminent paleontologists, Marquis de Saporta and Professor William C. Williamson. In the author's judgment, the most important contribution of the former to science is the conclusion that the most important subdivisions of the geological scale must be drawn at different points for plant development from those at which they are commonly drawn for animal development. For example, the Mesophytic age properly

ends with the Jurassic instead of with the Cretaceous, while the tertiary for fossil plants closes with the Miocene instead of with the Pliocene.

Of the many important discoveries made by Williamson, the most valuable is the demonstration of the existence of exogenous structure in the Carboniferous Pteridophytes. (Science, Vol. II, 1895.)

The Appalachian Folds.—The faults and folds in Pennsylvania Anthracite beds are most admirably shown by Dr. Benjamin Smith Lyman in a paper illustrated by thirty-three page plates containing 177 sections. These sections were prepared by the author from the valuable cross-section sheets of the State Geological Survey, and are accompanied by a key map showing where the sections are made. From a comparison of these cross sections Dr. Lyman draws the following conclusions:

"Steep northerly dips in the Pennsylvania anthracite region are much less prevalent than was formerly supposed; nearly half the basins and saddles are about symmetrical; nearly three-fourths of the subordinate ones are so in the Western Middle field; less than quarter of the main ones are so in the Southern field. Again, the subordinate folds throughout the region are confined to subordinate groups of beds of inferior firmness, and are not parellel to the main folds, but probably at uniform profile distances from the main axes, so as to descend the flanks of a sinking anticlinal. Further, that the faults are most invariably longitudinal or reversed faults, occasioned by the overtraining of subordinate folds, and corresponding in three-fourths of the cases to an overturned southerly dip, with the upthrow to the south; such broken subordinate folds, whether dipping southerly or northerly, ride in equal number on the northerly dipping and southerly dipping sides of the main folds; the stratigraphic throw averages only about 62 feet, and never exceeds 160 feet; the displacement averages 72 feet, and never exceeds 240 feet." (Trans. Amer. Institute Mining Engineers, 1895.)

The Ancestry of the Testudinata.—In the NATURALIST for 1885, I advanced the hypothesis that the order of the Testudinata arose from the Paleozoic order of the Theromora. In the latter I included at that time the forms I afterwards distinguished as an order under the name of Cotylosauria. In 1892 (Transac. Amer. Philosoph. Society, p. 24) I specified that the Testudinata must have been derived from this latter order. It is now possible to bring positive evidence that this view is correct, since the anticipation so expressed is

now verifiable. Parts of the skeletons of a new form of Cotylosauria from the Permian bed has come into my hands, which represents a new family of the order, and one which may well have been ancestral to the Testudinata. (See NATURALIST, 1896, April for a description of the order). The family may be defined as follows:

OTOCŒLIDÆ fam. nov. Cranial roof excavated laterally behind, forming a large meatus auditorius. Teeth present, in a single row, not transversely expanded. Ribs immediately overlaid by parallel transverse dermoössifications, which form a carapace.

To this family I refer two new genera, viz., Otocœlus and Conodectes, which differ as follows:

Suspensorium directed anteriorly, except at free extremity; nostrils lateral; *Otocœlus.*

Suspensorium directed posteriorly; nostrils vertical; *Conodectes.*

OTOCŒLUS, has the following characters: Intercentra present. Teeth subconical. Mandible not projecting beyond quadrate. Clavicle expanded at both extremities, overlapping the episternum. Scapula with a proscapular lamina. Ribs transversely expanded, not united by suture with each other, alternating with the dermal bands. Limbs well developed.

The type species of the genus Otocœlus is the

OTOCŒLUS TESTUDINEUS sp. nov. The skull is short wide and flat, and the orbits are large and are situated near the auricular excavations. Surface roughly sculptured with small pits and ridges. Malar and mandibular bones shallow. Teeth small, co mpressed conic smooth, and without serrations. Scapular arch without sculpture of the inferior surface. Humerus with widely expanded head and narrow shaft. Bands of carapace of moderate transverse extent, and roughly sculptured with pits and tubercles, Width between auditory meatuses 74 mm.; do. between orbits 32 mm.; do. between auditory sinus and orbit 16 mm.; transverse diameter of orbit 30 mm.; depth of mandibular ramus below middle of orbit, 28 mm.; width of carapace 80 mm.; length of clavicle 80 mm.; transverse width of head of humerus 35 mm.; length of femur 67 mm.; length of vertebral centrum 10 mm.; width of do. 19 mm.; width anterior rib distally 11 mm.

A second species is the *O. mimeticus* Cope. But one species of Conodectes is known, the *C. favosus* Cope.

This form is of especial interest since it constitutes, with the genus Dissorhophus which I described in the NATURALIST for 1895, p. 998, a remarkable example of homoplassy. It is doubtful whether the carapaces of the two forms could be distinguished externally, but Dissorhophus is a Stegocephalian Batrachian with rhachitomous vertebræ,

while the present form is a Cotylosaurian reptile. Although so similar superficially, the carapaces of the two differ as follows. In Dissorhophus transverse expansions of the neural spines of the vertebræ support the transverse dermal bands below, and the ribs are free, and only reach the border of the carapace by their extremities. In Otocœlus the neural spines are not expanded, and the dermal bands rest immediately on the ribs.—E. D. Cope.

The Extent of the Triassic Ocean.—In a short note contributed to the Paris Academy of Sciences on December 30, Prof. Iness calls attention to the striking geographical results of the researches of his Vienna colleagues on the marine Triassic fauna. While to English geologists the Trias is the typical example of an unfossiliferous land deposit, the work of Mojsisovics on the contemporaneous deposits of the Alpine region has been the starting point for a series of discoveries in many parts of the world. A rich marine Triassic fauna is now known, extending from Spain to Japan and California, and from Spitzbergen to New Zealand. Yet among the thousands of these fossils gathered together in Vienna from all parts, there is not a single marine fossil from the regions bordering the Atlantic or Indian Oceans. The conclusion is obvious, thas the regions of these modern oceans were not covered by sea in Triassic times. On the other hand, all the districts bordering the Pacific and Mediterranean yield the marine forms, as does a great stretch of land extending from the Mediteranean to the Pacific through Central Asia, and another extending from the Pacific through Eastern Siberia to the Arctic Ocean. Thus the Pacific Ocean was the main ocean in Triassic times, and stretched out two arms across the continental region—the one called the Tethyan ocean, of which the Mediterranean is the last remnant, the other, the Arctic branch. This distribution of the Triassic seas strikingly agrees with that of the structural features of modern coast lines indicated by Neumayr: the oceans bordered by lands with marine Trias are the oceans of the *Pacific type*, of which the coasts are determined by the convex margins of earth folds; while the oceans of *Atlantic type*, of which the margins cut across the mountain folds, are those around which the only fresh water Triassic strata are found. Thus is confirmed the opinion that the latter oceans are of comparatively recent origin, and have been produced by a process of wholesale depression, which has cut off the three great triangular upstanding masses (or *horsts*) of Greenland, Africa and India, which form so striking a feature on the surface of our planet. (Nature, Jan., 1896.)

The Ancient Beaches of Erie and Ontario.—In his correlation of the moraines of western New York with the Raised Beaches (Crittenden and Sheridan) of Lake Erie, Mr. Leverett makes the following statement in regard to the Lake Outlets:

"The evidence is clear that during the formation of the upper two beaches an outlet was found to the Wabash, past Fort Wayne, Indiana. At the time the third or Belmore beach was formed (and its probable continuation, the Sheridan beach) this outlet had been abandoned. It is thought that the ice sheet had retreated so far from the Huron and Michigan basins as to open a lower outlet through these basins than past Fort Wayne. It seems improbable that an eastward outlet was then open, for the district south of Lake Ontario was apparently still occupied by the ice sheet. It is evident that no outlet to the east could have existed until the ice sheet had withdrawn from the Lockport moraine sufficiently for a passage eastward along its southern margin. If my interpretations are correct, the Crittenden beach had been for a long time occupied by the lake before an eastward outlet was opened, a time sufficient, not only for the Lockport moraine, but for several other slightly older minor moraines to be formed. During that time, the lake in all probability discharged westward through the Huron and Michigan basins past Chicago. When the gates to the eastward were opened by the withdrawal of the ice sheet there was probably a brief period in which the lake discharged through the Seneca Valley into the Susquehanna. But soon the lower outlet by the Mohawk was opened and the lake fell rapidly to that level, leaving but feeble traces of beach or wave action in its intermediate stages." (Amer. Jour. Sci., Vol. L, 1895.)

Geological News.—GENERAL.—The periods of volcanic activity in New Brunswick, as stated by Wm. D. Matthews, are:

1. *Huronian.*—Southern New Brunswick and the northern watershed.

2. *Silurian and Early Devonian.*—Passamaquoddy Bay, Baie Chaleur, etc.

3. *Sub. Carboniferous.*—Borders of the central plain, Grand Lake, Blue Mountains of the Tobique.

4. *Triassic.*—Quaco, Grand Manan. (Bull. Nat. Hist. Soc., New Brunswick, No. XIII, 1895.)

PALEOZOIC.—The "shists lustrés" of Mont Jovet are shown by Dr. Gregory to be older than the Trias (1) by the occurrence of fragments of the schists in the Trias; (2) by the discordance of strike between the two series; (3) by the occurrence of masses of dolomite resting unconformably on the flanks of the shists; and (4) by the fact that the Trias has escaped the metamorphism which the schists have undergone. (Quart. Journ. Geol. Soc., 1896.)

Mr. C. H. Gordon's investigations of the St. Louis and Warsaw formations in southeastern Iowa furnishes evidence in favor of Calvin's

conclusion that dolomites are essentially offshore products. (Journ. Geol., Vol. III, 1895.)

Cenozoic.—Certain data accumulated by H. B. Kümmel indicate the glaciation of Pocono Knob and Mts. Ararat and Surgar Loaf in Wayne County, Pennsylvania. It has been hitherto held by the Pennsylvania State Geologists that these peaks were nunataks. (Amer. Journ. Sci., 1876.)

According to Dr. Grossmann, glacial phenomena in the Færoes comprise roche moutounées, glacial striæ, glacial mounds and boulder clay. The author states that there is no doubt that the islands had a glaciation of their own, a conclusion which is inconsistent with the hypothesis of a big northern ice cap. (Geog. Journ., Vol. VII, 1896.)

M. Harlé has identified the canine tooth and phalangeal bones of a lion, two molar teeth of a reindeer, and a molar tooth of an elan (Alces) in the fragmentary specimens from the Tourasse caverns in the southwestern part of France. From the evidence of other remains, M. Regnault fixed the age of this cave as intermediate between late Paleolithic and Neolithic. The presence of lion remains at Tourasse shows that this carnivore lingered long in the Pyrenees. (L'Anthropol., 1894.)

Cave Explorations in Tennessee.—We discovered the tapir-peccary layer in the cave breccia together with a later fauna in a layer of cave earth, associated with Indian remains, in Zirkel's Cave near Mossy Creek, east Tennessee. Prof. Cope, our informant, had previously found the former in 1869.—H. C. Mercer.

BOTANY.[1]

The Conifers of the Pacific Slope.—Every botanist who is interested in the Conifers (and what *botanist* is not?) will be pleased with the pocket edition of Mr. J. G. Lemmon's "Hand-book of West American Cone-bearers," which appeared somewhat less than a year ago. It is a duodecimo volume of about a hundred pages, and includes seventeen half-tone plates, from photographs, of the foliage, cones, and other characteristic features. The text consists of brief descriptions of the genera and species, interspersed with notes, discussions and narra-

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

tion. In a prefatory note we are informed that this is but a prodrome to a complete work which the author has in preparation, in which full scientific and popular descriptions are to be given. The little volume before us with its modest price of but one dollar should find its way into the library of every botanist, and all will look with expectation to the completion of the larger work.—CHARLES E. BESSEY.

Still another High School Botany.—It will not be the fault of the book-makers if the young people of the country are not versed in Botany, for one scarcely takes up a scientific journal nowadays without finding an announcement of some forthcoming book, or of one just issued. It is a sign of much botanical activity in the public schools, for it is very certain that the publishers are bringing these books out in response to what they regard as a sufficient demand. The last one on our table is the Elements of Botany prepared by J Y. Bergen, instructor in Biology in the English High School of Boston. It is, we are told in the preface, "for the most part an expansion of the manuscript notes which have for some years formed the basis of the botany teaching in the Boston English High School." The book is thus to a large extent a growth ; and not a creation. It looks usable, and what is more it has every appearance of being a profitable book to the user. An importance feature of the work is found in its many physiological experiments and observations which are to be made by the pupil. The whole work has a strong physiological bias which will be of much value in leading the pupil to the study of the plant in action, rather than to the identification of species.

Still with all its excellence the book presents the elements of botany in a fragmentary way. After over two hundred pages given to flowering plants, we find but twenty-seven pages given to "Some Types of Flowerless Plants." The pupil will imbibe the notion from this book that the flowerless plants are of less importance than those which receive so much more attention. The book should be called the Elements of the Anatomy and Physiology of the Flowering Plants, and thus restricted it is admirable ; but the author was not warranted in calling it the elements of Botany, that is of the whole science, for it certainly does not present the elements of the *science* of Botany. We are glad to note in the very much abridged Flora at the end of the book a departure from the usual sequence of families, but we regret to see that the Gymnosperms, while given their proper place below the Angiosperms, are described in accordance with the old views as to their morphology. When we describe the staminate cones of the pine as catkins of monandrous flowers, and the ovaliferous cones as catkins of

"spirally arranged carpel scales," we must be consistent, and put the Gymnosperms where Bentham and Hooker, Gray and Watson put them, as the simplest of the Apetalæ.—CHARLES E. BESSEY.

Popular Botany.—We frequently deplore the ignorance of people in general as to the main facts of botanical science, and sometimes we berate them for not taking more interest in what we find so attractive. Yet when we are asked to recommend a book to a non-botanical friend we are sorely puzzled. It is true that we may name Kerner's Natural History of Plants, which no doubt if well read would be greatly edifying, but it costs so much, and is so big a book that few can afford the time or money it demands. We know that it is regarded by many botanists as quite the thing to sneer at Grant Allen's books on plants, but we are not of these, and on the contrary have always admired his ability to state scientific facts—dry facts too—in a way which makes them readable and even entertaining. In his latest booklet—The Story of the Plants—he maintains his reputation for entertaining and at the same time instructive writing. We commend it to the non-botanical who wish to get some general notions of plants, and may we also make bold to suggest that our severely critical and truly scientific botanists run it through. It may be suggestive to them, even.

The author pleasantly tells us "How plants began to be," "How plants came to differ from one another," "How plants eat," "How plants drink," "How plants marry," "Various marriage customs," "The wind as a carrier," "How flowers club together," "What plants do for their young," "The stem and branches," "Some plant-biographies," "The past-histories of plants." That he makes slips here and there may well be granted, but not more, we venture to say, than are made by authors of some more ambitious works.—CHARLES E. BESSEY.

Notes of Botanical Papers.—Edward C. Jeffrey in the December *Annals of Botany* figures and describes polyembryony in *Erythronium americanum*, in which *four embryos* developed in each ovule by the division of the fertilized oosphere.—The freshwater Chlorophyceæ of Northern Russia, are enumerated by O. Borge, in a 40 page paper, accompanied by three plates, the latter mainly of new species or varieties.—The Adirondack Black Spruce is treated fully, both economically and scientifically by Wm. F. Fox the superintendent of state forests for New York, in the Report of the Forest Commission for 1894. This paper has been issued under its title as a separate book of eighty-two pages. It is illustrated by many half-tone and two colored plates. —A. P. Morgan continues his studies of North American Fungi in the

Journal of the Cincinnati Society of Natural History (April–July, 1895) and describes some new genera and species. Three plates accompany the paper, giving illustrations of every species.—In *El Barbareno* (Santa Barbara, California), Mrs. Ida Blochman writes pleasantly and instructively about the California wild flowers. Such papers will do much to help acquaint busy people with the plants about them. It would be well if botanists elsewhere were to imitate Mrs. Blochman.—The recent death of Julien Vesque July 25, 1895) brings to us a series of necrological papers by Dehérain, Bonnier, Duclaux, Schribaux and Bertrand, accompanied by a photogravure of the lamented investigator. Julien Vesque was born in Luxembourg, April 8, 1848, educated in the Grand Ducal Atheneum of Luxembourg, studied in Berlin (under Braun and Kny) and afterwards in Paris with Brongniart, Duchartre and Decaisne. He was early made a member of the Institut Agronomique, in which he was an active worker at the time of his death. The collected titles of his botanical papers number sixty-seven, covering twenty-two years (1873–1895).—Lewis's Leaf-Charts promise to be very useful. They consist of very accurately drawn life-size drawings of characteristic leaves of North American trees. Their moderate price (50 cents per chart, 22 x 28 inches) should warrant their being placed in many of the public schools.—Century III of C. L. Shear's New York Fungi is now in course of distribution. It will prove to be of more than usual interest containing as it does several new or recently described species. This distribution of fungi has met with unusual success, every copy of Century I having long since been taken, no doubt due to the excellence of the specimens. It should be mentioned that the author has removed to Lincoln, Nebr. where he is engaged in botanical studies.

VEGETABLE PHYSIOLOGY.[1]

Change in Structure of Plants due to Feeble Light.—The evidence that new species of plants are developed directly and rapidly out of old ones by changes in the environment is becoming more and more conclusive each year. Plants put into markedly different surroundings either perish or become rapidly modified to meet the changed demands made by the new conditions. One of the most recent and

[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

interesting pieces of evidence is that brought forward by M. Gaston Bonnier in a long article,—Influence de la lumière électrique continue sur la forme et la structure des plantes,—running through four numbers (78, 79, 80 and 82) of the *Revue génerale de Botanique*, Paris, 1895. In a previous study (Les plantes arctiques comparées aux mêmes espèces des Alpes et des Pyrénées, *Rev. génerale*, VI, 1894, p. 505) M. Bonnier had shown that arctic plants differ noticeably from the same species growing in alpine regions, e. g., in the greater thickness and simpler structure of the leaves, and had attributed this to the feebler light of the arctic region and to the greater degree of moisture. By means of feeble electric lighting and a moist cool temperature he has now been able to produce these differences synthetically in Paris, i. e., to take alpine plants and convert them into arctic ones. He has also shown by experiments on a great many plants, details of which are given, that feeble continuous electric lighting for a period of six months causes decided histological and morphological changes in nearly all of them, except such as grow in the water. Many plates are given in connection with this paper showing morphology and histology of normally grown and continuously lighted plants and the changes in the structure of the latter are frequently so great that no one would believe the sections to have been derived from the same species. About 75 species were experimented on and these belonged to many different families. The structural changes obtained in *Helleborus niger*, *Fagus silvatica*, *Pinus austriaca*, *Picea excelsa*, and *Pteris tremula* are particularly striking. To illustrate, in the needles of Pinus the characteristic arms or folds of the cortical parenchyma disappear entirely and there are several other equally striking changes. In Pteris the petiolule under the influence of the continuous electric light takes on an epidermis which is clearly distinct from the subjacent cells, and the cells of which are elongated perpendicularly to the surface of the petiole and are much larger than the neighboring layers of cortical tissue while their walls are not thickened; the cell layers immediately under the epidermis (sclerenchymatic tissue) do not become thick-walled and are rich in chlorophyll; the intercellular spaces in the cortical parenchyma have wholly disappeared; and, finally, there is no endodermis, although it is well developed in the normally lighted plant. The palisade tissue was imperfectly formed in bright electric light and in many cases entirely disappeared in feeble electric light thus confirming what has been believed for some time on other grounds, namely that the development of the palisade tissue of leaves stands in direct relation to the intensity of the light. Additional experiments seemed to indicate that most of

the results obtained were due not to the kind of light but to the grade of intensity. The whole paper will repay careful perusal. The author's main conclusions are given in the following paragraphs, as nearly as possible in his own phraseology: *Modifications due to continuous electric light.* The organs completely developed in continuous light have the following characters: (1) The chlorophyll is more abundant and is more uniformly distributed in all the cells which contain it under normal lighting. Moreover, chlorophyll grains may appear even in elements which do not contain them in a normal state, in the bark clear to the endodermis, or even in the medullary rays, in the pith, sometimes even to the central cells of the pith. (2) The structure of the blade of the leaf is simplified; the palisade tissue is less distinct or disappears entirely, the epidermis has cells with thinner walls, and the cortical cells lose their special differentiations (transformation into sclerenchyma of the petioles of the fern, reduplication of the membrane of the cortical cells of the needles of the pine, etc.). (3) The structure of the stem is simplified; the bark is less clearly divided into two different zones or even has all its elements alike; the cork is tardy or but little developed, the endodermis is less well defined, or is no longer distinct from the neighboring cells; the cortical tissue, the tissue of the medullary rays, and that of the pith are composed of elements which more nearly resemble each other; the sclerification and the lignification of the pericycle or of the wood fibres is diminished or disappears entirely; the interior calibre of the vessels is often greater; the perimedullary zone and the libre are less differentiated.

It may be added that the structure in discontinuous electric light approaches more nearly the structure in normal light than that in the continuous electric light. Finally, it should be noted that this latter is intermediate between the normal structure and that in obscurity, except the greening. The simplification of structure under continuous feeble electric lighting is, therefore, to be ascribed partly to the continuity of the light and partly to its feebleness. To sum up, a sort of *green etiolation* is produced by continuous electric lighting, for the two principal characteristics of the changes obtained are the superabundance of chlorophyll and the simplification of the structure.

Somewhat similar results may be obtained by growing plants for some time in weak daylight in the middle of a room and then comparing their structure with that of the same species cultivated in the bright light of a window. Modifications of form and cell structure are still more pronounced if the same plants are grown in total darkness. Anatomical characters are sometimes used in classification and M.

Bonnier suggests that the electric light may be used to determine which of these are most constant.—ERWIN F. SMITH.

A Graft Hybrid.—At a meeting of the Biological Society in Christiana, Nov. 21, 1895, Prof. N. Wille, the well known algologist, exhibited the fruit and leaves of a so-called graft hybrid which is said to have resulted from the working of a pear upon a white thorn (*Cratœgus oxyacantha* L.). This tree stands in the Hofe Torp in Borge Kirchspiel in south east Norway. According to the statement of Herr Apotheker Johns. Smith, of Fredriksstad, the tree is about twenty years old and stood for fifteen years in an unfavorable place without blossoming. It wa then set in a better place and has blossomed and borne fruit for five years. The flowers are like those of the pear tree but somewhat smaller and borne in corymbs like those of *Cratœgus.* The pedicels and the fruit are smooth, but the calyx lobes are triangular and woolly hairy with the tips somewhat bent back. The small fruits (1·5 to 3 cm. long by 1·3 to 2 cm. broad) are pear-shaped but with the color of *Cratœgus* fruits. The fruits are five-celled and usually with two sterile seeds in each compartment; the pericarp is somewhat firmer than the flesh of the fruit and recalls the so-called stone of the *Cratœgus* fruit, but is by no means so hard. The taste of the flesh is insipid and lies between the taste of the pear and that of the white thorn. All the fruits examined by Prof. Wille contained only sterile seeds, but Herr Apotheker Smith stated to him that he once found a single perfect seed. The leaves of the tree have retained the appearance of pear leaves and do not appear to be changed, but out of the wild stem below the point of union shoots of the white thorn now and then grow out and these have the characteristic leaves of that tree. This account is taken from *Biologisches Centralblatt,* Bd. 16, No. 3, Feb. 1, 1896. It would add much to the credibility of this case if it could be learned when, by whom, and from what sort of pear tree this white thorn was grafted. A sceptical pomologist suggests that the top of this tree may possibly be the Japanese *Pirus Toringo,* or some allied species.—ERWIN F. SMITH.

Ustilaginoidea. The following note should have appeared in the March number of this journal, p. 226, after BIOLOGY OF SMUT FUNGI, in connection with which it should be read.

NOTE.—Since the above was written, Dr. Brefeld has succeeded in discovering the full life history of *Ustilaginoidea.* The sclerotia, after lying on damp sand for six months, developed an ascus fructification closely resembling *Claviceps.* Dr. Brefeld's last paper on the subject

may be found in a recent number of *Botanisches Centralblatt*, Bd. 65, No. 4, 1896. It is entitled, Der Reis-Brand und der *Setaria*-Brand, die Entwicklungsgleider neuer Mutterkornpilze.—ERWIN F. SMITH.

ZOOLOGY.

Respiration of Trilobites. Dr. C. E. Beecher comments as follows on the probable method of respiration of the trilobite genus, Triarthrus. "No traces of any special organs for this purpose have been found in this genus, and their former existence is very doubtful, especially in view of the perfection of details preserved in various parts of the animal. The delicacy of the appendages and ventral membrane of trilobites and their rarity of preservation are sufficient demonstration that these portions of the outer integument were of extreme thinness, and therefore perfectly capable of performing the function of respiration. Similar conditions occur in most of the Ostracoda and Copepoda, and also in many of the Cladocera and Cirripedia."

"The fringes on the exopodites in Triarthrus and Trinucleus are made up of narrow, oblique, lamellar elements becoming filiform at the ends. Thus they presented a large surface to the external medium, and partook of the nature of gills." (American Journal Science, April, 1896.)

A Criticism of Mr. Cook's Note on the Sclerites of Spirobolus.—I have read with some interest Mr. Cook's description[1] of certain lines found upon the rings of a specimen of *Spirobolus marginatus*, but I am unable to agree with him in the conclusions drawn from them, nor with his remarks relative to the diplopod segment in general. It seems somewhat surprising that Mr. Cook made no examination of the musculature, either of the specimen described or of any other, to determine whether the lines discovered coincided in any way with lines of muscular attachment, an examination that is necessary to give his conclusions more than a very superficial footing. Had he made the examination, it is extremely doubtful whether he would have found this necessary data, since in more or less closely related forms no lines of attachment corresponding to his lines are to be found.

[1] This journal, p. 333.

Indeed there are many facts that he either ignores or of which he is unaware that are far from lending support to his interpretation of the lines. Some of these I have pointed out elsewhere [2] when considering the subject of the diplopod segmentation. Mr. Cook seems unfortunate in thinking of the greatly overgrown dorsal plate in the diplopod ring as the segment or somite, and in drawing his comparison from the geophilids. Had he examined the conditions occuring in the pauropods and those in *Lithobius*, *Scutigera* and scolopendrids, and taken into account some of the ontogenetic facts known regarding diplopods, he doubtless would have plainly seen indications of alternate plates (not segments) having disappeared and of the remaining plates over-growing the segments behind them, so as to give rise to the anomalous double segments. There would then have been no reason for bringing forward the most decidedly unprogressive supposition, namely, that the double or apparently double condition of the diplopod segment is a condition *sui generis* unexplainable upon general morphological principles.

With reference to his supposition that alternate leg pairs have disappeared even in the geophilids, the case that he has in mind in mentioning the Chilopoda, I must say there is no evidence whatever. To adduce the geophilid condition as evidence is to adduce the thing to be explained. Therefore, I at least am not able to agree with him in saying that this view is no more fantastic than the old fusion idea of Newport, since the latter has some real ground and many favorable appearances in its support, even though it be incorrect.

—F. C. KENYON.

The Sight of Insects.—M. Felix Plateau has been conducting a series of experiments to settle the question as to whether an insect in flight will go through a net the size of whose meshes would offer no obstruction to the passage of the insect. The question has a bearing upon the difference of vision of Insects and Vertebrates. Mr. Plateau's recent experiments would seem to confirm the statement made by him in 1889 that the vision of insects is obscure as to form, and is adapted more to the perception of movements.

The data upon which the paper is based were acquired by means of ingeniously contrived nettings of various shapes, with meshes 26 to 27 millimeters and 1 to 2 centimeters in size. These nets were placed over attractive lures, such as flowers that insects frequent and in other cases decaying animal matter. The results of the author's observations are given in the following conclusions:

[2] The morphology and classification of the Pauropoda, Tufts College Studies No. 4.

"1. A net extended does not arrest the flight of insects in every case."

"2. During flight the insects act as if they did not see the meshes of the net."

"3. A direct passage by flying is always rare. In the great majority of cases the insect hurls itself upon the net where it rests on one of the threads, and then passes through as any other animal would go through an opening which it discovers."

"4. The only explanation possible for these facts rests on the defective vision due to the compound eyes of Insects. The threads of the net produce in the insect an illusion of a continous surface, just as the cross-hatchings of an engraving do for a human eye. The Arthropod believes itself to be confronted by an obstacle, more or less translucent, in which it can perceive no openings." (Bull. Acad. Roy. Sciences Bruxelles, Nos. 9-10. 1895.)

Dr. Baur on my Drawings of the Skull of Conolophus subcristatus Gray.—In the No. of the Naturalist for April (last p. 238), Dr. Baur criticises Steindachner's drawings of the skull of the above species and my copies of them published in the Naturalist for February, p. 149. He says of the former: "These drawings have not been made to show the detailed relations of the different elements of the skull. Especially the regions copied by Cope are drawn quite insufficiently. The sutures between the different elements can not be made out." To this I have to remark that the sutures between the quadrate and adjacent bones are distinctly drawn, and can be made out perfectly well by any one familiar with the subject, but some of the others are less distinct. Dr. Baur then goes on to say that "Prof. Cope's drawing are not exact tracings from Steindachner for he has drawn sutures which do not exist at all in Steindachner's figure. There is no such suture between the postorbital. Pob, and his supertemporal, St., in the actual specimen, nor in Steindachner's drawing. * * In Prof. Cope's figure the outer and upper portion of the distal end of the paroccipital process separates the parietal process from the prosquamosal (supratemporal Cope.) This is not the case; the parietal process is always united with the prosquamosal. * The prosquamosal (supratemporal Cope) is also drawn quite incorrect; besides, its true relations cannot be made out at all from Steindachner's figures * *"

It will be noticed that in the above criticism nothing is said about the articulation of the quadr ate with the exoccipital, which is the

question at issue between us; I alleging that the articulation exists, and Dr. Baur denying it. Dr. Steindacher's figures show conclusively that the articulation exists, as it does in nearly all other Lacertilia, and Dr. Baur has not alleged that this plate is wrong in this particular, or that my tracing of it is not an exact copy. On comparing my tracing with the original again, I find that it is an exact copy, and that if any errors exist they are altogether irrelevant to the question at issue. The separation of the parietal process from the superatemporal is shown in Steindachner's plate, but it may be erroneously, as Baur alleges. The suture separating the postorbital from the supratemporal in my drawing may also be an error, but it represents a feature of Steindachner's drawing, which he did not perhaps intend for a suture, although it looks like it. These two points are obscure to the eye without close examination, and it is probable that Baur is right as to their condition in nature. They however do not discredit the accuracy of the conspicous features of the articulations of the elements with the quadrate, which I find to agree with other Iguanidæ.

Dr. Baur's assumption as to what I " really believe," is not quite correct, as can be easily seen by reading my previous articles. What I have endeavored to show is that until the character of the paroccipital (squamosal Baur) of the Pythonomorpha is explained, I hold that the determination of that element as squamosal as is made by Baur, is premature. I am agnostic, and am open to conviction, but Dr. Baur has not yet convinced me.—E. D. Cope.

Zoological News. The Tokio Zoological Magazine, for 1895, Vol. VII contains an account by R. Mitsukuri of a Japanese species of Hariotta, for which he proposes the name *H. pacifica*. The type species of this remarkable chimaeroid genus is now in the U. S. Natl. Mus. It was found in deep water off the coast of Virginia and described by Goode and Bean under the name *H. raleighana*. See Naturalist 1895 p. 375 Plate XIX. The Pacific form agrees with the Atlantic one in general appearance, especially in the elongate muzzle and feeble claspers, but differs in five essential points which are enumerated by the author. The occurrence of this interesting genus in both the Atlantic and Pacific Oceans is an interesting fact.

Recent explorations in the Gulf of California along the coast of Sinaloa have resulted in a collection of fishes, which while yielding 232 species, by no means exhausts the richness of that locality. The collection was sent to Prof. Jordan for identification. Thirty new species were found among the specimens, all of which are described

and figured in the proceedings of the Calif. Acad. Sci. Vol. V. 1895.

Among the new fishes described during the past year is *Razania makua* from the Hawaiian Islands. The species is very rare, only two specimens being known. It is a deep-sea fish by habit, and is especially remarkable for its rapidity in swimming. A colored plate accompanies the description given by Mr. O. P. Jenkins in the Proceeds. Calif. Acad. Sci. Vol. V., 1895.

Two new genera and species of fishes, belonging to the family Percophidæ, are reported from Australia, by J. D. Ogilby. They are described by him under the names *Centropercis nudivittis* and *Tropidostethus rothophilus*. The latter are surf-fishes, never descending to the bottom, but swimming a few inches beneath the surface of the water. (Proceeds. Linn. Soc. N. S. W. (2) Vol. X. Pt. 2, 1895.)

In an examination of 52 specimens of *Vipera berus* from Denmark, Mr. Boulenger finds a wide range of individual variation. The differences observed are in the shape of the snout, the scaling of the head, body and tail, size and coloration. The observations as to color confirm those previously made by Geithe in Germany. (Zoologist, 1895.)

The same anthor in a recent classification of the American Box Tortoises in the British Museum, adopts Baur's definitions of species and distinguishes six of which he gives a synopsis. He holds to the generic name of Cistudo although it has been shown that Terrapene has priority. Ann. Mag. Nat. Hist. 1895.)

ENTOMOLOGY.[1]

A New Diplopod Fauna in Liberia.—From the west coast of Africa large numbers of Diplopoda are already known, and yet very little of the vast extent of territory has been thoroughly searched for members of this group. In connection with an attempted exploration of Liberia under the auspicies of the New York State Colonization Society, there has been an opportunity for careful collecting in the western part of that country, some of the results of which are here offered. The majority of Liberian Diplopoda belong to the suborder Polydesmoidea. The only other families represented are the Polyxenidæ, Stemmatoiulidæ, Spirostreptidæ and Spirobolidæ, and these offer no very remarkable novelty in structure or form. This is in strong contrast to the great number and variety of Polydesmoidea; indeed it

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

has proved necessary to establish genera and families in attempting to properly recognize their structural novelty and diversity. Some of these new groups have already received names,[2] but their characters have been only formally indicated.

Family Ammodesmidæ.

Two minute Glomeroid genera were discovered, one of which, Ammodesmus, is the smallest member of the suberder, if not of the entire class. The only species, *Ammodesmus granum*, is less than two millimetres long, and about half a millimetre broad. A single specimen was secured while collecting minute Oniscidæ, but diligent and repeated search failed to find another. It did result, however, in three specimens of a very distinct, though evidently allied, genus which it is proposed to name Cenchrodesmus. Both genera have the habit of coiling into a sphere. The second segment is enormously enlarged so as to completely conceal the head and first segment when viewed from the side, as well as to cover the space left between the decurved carinæ of the other segments when the creatures are coiled. Ammodesmus has the dorsum roughened by a transverse row of large papilliform tubercles rising from the posterior part of each segment, while *Cenchrodesmus volutus* has the segments nearly smooth. The surface of Ammodesmus is rough and dusted with earth. When disturbed it coils up and lies motionless, and is then perfectly concealed, having exactly the appearance of a grain of sand. My specimen would certainly not have been seen had it not been crawling. Cenchrodesmus is pinkish in life and mottled with pale horn-color in alcohol. Both genera live on the ground under decaying wood or leaves.

Family Campodesmidæ.

This also contains two genera similar in size and general shape, yet evidently distinct, in that Campodesmus has the segments ornamented with two conspicuous clusters of coarse tubercles, while *Tropidesmus jugosus* has two transverse rows of short longitudinal carinæ, a form of sculpture previously quite unknown in Polydesmoidea. The carinæ are depressed in both genera, and the dorsal surface is very rough with fine granules and tubercles. Pores are visible on the fifth and seventh segments, but I have been unable to find them on the others. Both forms are denizens of the deepest forests, where the light is so deficient that they are sure to be overlooked unless specially sought for. They are very sluggish in their movements, and are seldom found crawling. When disturbed they coil up into a spiral, and also assume that posi-

[2] Proc. U. S. Nat. Museum and Annals N. Y. Acad. Science, 1895.

tion in alcohol. The first segment is not enlarged to conceal the head, nor are the anterior segments larger than the others. The general appearance is strikingly different from that of other Diplopoda, the resemblance being rather to certain lepidopterous larvæ.

Familly COMODESMIDÆ, new.

The type of this family is a small, reddish-brown, subcylindrical form, very rare, and also inhabiting the denser parts of the forest. The pore-formula is unique: 5, 7, 9, 12, 15, 17, 18. The pores are located in the front part of the posterior subsegments. The dorsal surface is beset with conic piliferous granules, giving a wooly appearance. The last segment is scarcely produced beyond the anal valves, but is rounded off at apex as in many Iulidæ. The head is not concealed by the first segment, which is narrower than the second and somewhat included between the carinæ of the latter, much as in *Scytonotus granulatus* (Say). Two other allied genera, also granular and hairy, are found in similar situations in Liberia, but both have the normal pore-formula as in Polydesmus. Thelydesmus is nearly black, larger and much more abundant than Comodesmus. The generic name alludes to the fact that the females are in a large preponderance. Although about a hundred females were taken, careful and extended collecting resulted in only four males. The remaining genus is minute and very rare, cylindrical, and without carinæ. The posterior subsegments are abruptly thicker than the anterior, giving the appearance of a series of of discs laid together, whence the generic name, Discodesmus. In the Berlin Museum is another form evidently allied to Thelydesmus, but with broader carinæ and more resemblance to the Pterodesmidæ, to be noted later on. It was collected in the German Colony of Togo by Dr. K. Büttner, and may be known as *Xyodesmus planus.*

In addition to the above genera there may be referred to this family Cylindrodesmus Pocock, from Christmas Island. It is even more evidently allied to Comodesmus than the other genera mentioned. There is also in my collection a new generic type from the mountains of Java, not closely related to the other genera, but evidently belonging to the same family group.

Family PREPODESMIDÆ, new.

Under this name it is proposed to arrange West African forms hitherto referred either to Paradesmus or to Oxydesmus, from the latter of which they differ in having the apex of the last segment narrow and bituberculate. The affinities of the group seem to be with the Oxydesmidæ, although no connecting links have yet turned up. In a

large number of forms the poriferous segments are wholly or partly red or yellow, while the remainder of the body is nearly black, giving a most striking appearance. Prepodesmus includes several such forms, all with the anterior corner of the second segment greatly produced and embracing the first segment. Tylodesmus has the corner rounded and not produced. Cheirodesmus is similar to the last in general shape, but is more slender and with the male genitalia resembling in shape a gloved hand. Anisodesmus is peculiar in that the fourth segment is distinctly, though slightly, narrower than the third or fifth. The species are uniform dark red in color and the type is closely allied to *Polydesmus erythropus* Lucas. Isodesmus is evidently related, but with the fourth segment not narrowed, and remarkable in that the pores are not borne on a distinct callus as in the other genera of the group. The copulatory legs are also very peculiar being deeply divided into several laciniæ. In all these genera the dorsal surface is finely and evenly granular, though differing somewhat in other respects. The family is probably distributed along the entire West Coast, and I have seen two forms from South Africa, one of which, Lipodesmus, is in the Berlin Museum.

Family Oxydesmidæ.

The Liberian forms which belong to this family in the more limited sense[3] are all referable to the genus Oxydesmus, and belong to three species, *O. grayii* Newport, *O. medius* and *O. liber*, both new. The first is a very striking form, black in color with a narrow median stripe of bright vermillion. The other species are also black, *O. liber* with bright yellow submarginal ridges.

Family Polydesmidæ.

Of Liberian species referable to this family in its stricter sense there seem to be but two; small pinkish-red forms, similar in general appearance to some species of Brachydesmus. The dorsal elevated areas are each supplied with a clavate hair. The antennæ are strongly clavate, though rather slender, and the second pair of legs is crassate in the

[3] The African forms having the apex of the last segment broad, the femora spined, and the carinæ with a submarginal ridge, constitute the family Oxydesmidæ. There are five genera now known, two confined to the east side of the continent, three to the west. Of the east coast forms, Orodesmus includes those with strongly tuberculate segments, Mimodesmus those with the body slender and the dorsum nearly smooth. Of the west coast genera Oxydesmus has three rows of dorsal tubercles and surrounding areas; Scytodesmus has five or six rows, while Plagiodesmus resembles Oxydesmus, but has the submarginal ridges very broad and oblique, and the copulatory legs large and exposed.

male. For this genus the name Bactrodesmus is proposed; it will probably be found to be next related to the form described from Ceylon by Humbert as *Polydesmus cognatus*, but which is generically different from the European *P. complanatus*, and may be denominated Nasodesmus.

Family PTERODESMIDÆ, New.

This family is proposed for *Polydesmus gabonicus* Lucas and its African relatives, by more recent writers referred to Cryptodesmus. I have examined the type of *Cryptodesmus olfersii* in the Berlin Museum. The diversities seem to be of family importance. The African forms are very curious, the development of the lateral carinæ being carried to its greatest extent. They are very much flattened, elliptical in outline, and only four or five times as long as broad. They never coil into a spiral, even when placed in alcohol. At least five genera are found in Liberia.

All the African forms yet known to me have repugnatorial pores, and we may expect to find these in the others, notwithstanding the statements of several writers to the contrary. The location of the pores is, however, very unusual. They are far remote from the lateral margin, in the *anterior* part of the carinæ, in some cases so far ahead as to be concealed by the posterior margin of the preceeding segment. An even more remarkable condition obtains in *Pterodesmus brownellii*, the type of the genus and family. The fifth segment has no pore! The Liberian forms are further peculiar in that all are more or less pruinose. Pterodesmus is the largest of the Liberian genera. It is pure white when young, but mature individuals are usually dusted with earth which adheres to the pruinosity and gives them the advantage of protective coloration. Gypsodesmus, on the other hand, is pure white, even when mature. Lampodesmus is partly pruinose and appears to be black and white when alive, though it is brown in alcohol. It is structurally peculiar in that the sternum of the sixth segment bears two hollow processes fringed along their apical edges with long hairs. These may be of use as a protection to the copulatory legs. Composodesmus is the broadest of the Liberian forms. When alive it is one of the most varied and brilliant of Diplopoda. A large median area of the dorsal surface of each segment is dark brown, while the space between it and the posterior margin on each side is nearly white or bright yellow. Carinæ tinted with bright orange or pink, or both. Below, except near the edges of the carinæ, the body is covered with a pure white bloom or chalky powder. Last segment nearly white. Motions very sluggish.

From the German colony of Togo comes a genus evidently allied to the last, but distinct by reason of the more slender body and narrower carinæ, which are also scarcely produced at the posterior corners. From Lampodesmus it is distinct in the absence of the process from the sternum of the sixth segment, and in the form of the copulatory legs.

A small horn-brown or yellowish creature with remarkably agile movements it is proposed to name *Choridesmus citus*. The first segment is pure white, pruinose, and abruptly different in color from the remainder of the body. The pores are large, and are located in the middle of the carinæ, remote from the margins. The quick, jerky movements remind one strongly of Polyxenus.

Family STRONGYLOSOMATIDÆ.

Of this group there are two genera in Liberia, both new, though probably not confined to the West Coast. *Scolodesmus grallator* represents the usual Strongylosoma type, with long legs and antennæ. It is dark wine-color, nearly black. *Habrodesmus lætus* is a rare species apparently confined to the darkest forests. It is exceedingly quick and agile, very graceful in form and brilliantly colored. The legs are orange and pink, and the segments have the posterior margin yellow, shading through orange and brown to black on the remainder of the segment.

In gardens at Monrovia *Orthomorpha vicaria* (Karsch) is not uncommon; it is probably not indigenous.

Family STYLODESMIDÆ.

The type of this family is a bizzare creature named *Stylodesmus horridus*. The generic name alludes to the fact that the pores are borne on long stalks placed near the lateral margins of the broad, decurved carinæ. The pore-formula is the usual one, 5, 7, 9, 10, 12, 13, 15–19. The whole dorsal surface of the animal is setose and coal-black. There is almost always an incrustation of dirt which furnishes a completely protective coloration. The head is completely concealed under the flabelliform, anteriorly lobed, first segment, and the last segment is reduced, included in, and concealed by the penultimate. The most striking feature is that each of the segments except the last bears dorsally a pair of long slender processes. Those of the anterior and posterior segments are close together and show a tendency to unite at the base. These processes are also rough and setose, and almost always so incrusted with dirt as to appear several times their actual size. If segments of Stylodesmus had been found in fossil condition they would probably have been looked upon as allied to some of the

Archipolypoda, so much greater is the general resemblance to the fossils than to previously known extant genera. Yet there are in Liberia at least three other genera which have evident affinities with Stylodesmus. In all the pores are located on special processes or tubercles, and the first segment is enlarged and scalloped in front. *Udodesmus telluster* differs from Stylodesmus in being much more slender and without the long dorsal processes. These are replaced by two longitudinal crests of two or three large tubercles. The body is very rough, setose, and incrusted with earth. *Hercodesmus aureus* is a beautiful little species, more slender than Udodesmus, and usually without a covering of earth. In Stiodesmus the dorsal ridges of tubercles are not much more prominent than the numerous large, rounded tubercles with which the whole surface is beset. The result is a creature which on first view might be supposed to have affinities with Scytonotus.

Besides these, the present family will contain four East Indian genera, Pyrgodesmus and Lophodesmus, described by Pocock, and two new ones from Java. In the Canary Islands is a beautiful and evidently allied form inhabiting the nests of ants, and called Cynedesmus, on account of the form of the first segment. The Stylodesmidæ do not coil up into a close spiral; they usually remain nearly straight, even when in alcohol. Though there is no close resemblance in form or structure between the Stylodesmidæ and Campodesmidæ, yet both are strikingly different from other Diplopoda. That two groups of such remarkable creatures should inhabit the same locality seemed at first very strange, but as the various new and equally interesting forms continued to be found it was soon apparent that we were really in the presence of a new fauna.

That the new families are not all confined to Africa is shown by recent papers, notably those of Mr. Pocock. As yet, however, the Ammodesmidæ and Campodesmidæ are known only from African representatives. Of the larger, long known forms the Oxydesmidæ and Prepodesmidæ, appear to be confined to Africa. In East Africa is another family of several genera, none of which has yet been reported from the West Coast. Indeed, speaking with regard only to families and genera, there are four very distinct diplopod faunæ in the African continent, the northern, southern, eastern and western parts having little in common. The species are, of course, even more local. I have examined the collections of the Berlin Museum and the British Museum, as well as the literature of the subject, and with the exception of *Oxydesmus grayii* and *Orthomorpha vicaria*, collected at Sierra Leone, know of no Liberian diplopod from any other part of the West Coast.

We are thus assured of an African fauna of surpassing richness, not a tithe of which has yet been revealed.—O. F. Cook.

Entomological News.—Prof. Clarence M. Weed of the New Hampshire College spent several weeks in December and January, studying the Bermuda Islands. Many species not before recorded from there were collected.

EMBRYOLOGY.[1]

The Sense Plates, the Germ of the Foot, and the Shell or Mantle Region in the Stylommatophora.[2]—To our knowledge of these subjects, Dr. Ferdinand Schmidt contributes the results of his numerous observations upon the embryos of *Succinea*, *Limax* and *Clausilia*. Concerning the sensory plates he shows that immediately behind the budlike rudiments of the future egg-bearing and the simple tactile tentacles, in *Limax* where the development is most easily followed, there arises a third pair of buds like the first two pairs in all respects except in size. From these buds arises the so called oral lobes, subtentacular lobes, or labial tentacles. They have no relation to the velum whatever, since they arise in a pre-velar region. This is completely at varience with the observations of Jayeux-Laffuie on *Onchidium* and those of Ray Lankester on *Limnœus* in which the subtentacular lobes are asserted to arise from the velum or a rudiment of the same. Should further studies upon these forms substantiate the assertion, we would then have two groups of oral lobes, one in which they arise from the velum and to be homologized with the oral lobes of the lammellibranchiata, where they undoubtedly have such an origin, and the other in which they arise from the sensory plates and are homologous with the tentacles.

In his account of the development of the foot in *Succinea* he supports the conclusion long since put forth by Lankester, namely, that the typical form of the blastopore is an elongated cleft on the ventral side of the embryo, from which arises in some cases the mouth, in others the anus, according as the cleft persists anteriorly or posteriorly. This form of a blastopore is certainly important, considering his con-

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts reviews and preliminary notes may be sent.

[2] Beitrage zur Kenntniss der Entwicklungsgeschichte der Stylomatophoren, with 9 text figs. Zool. Jahrbücher, VIII, 318.

clusions with regard to the foot. This, he says, is to be distinguished very much earlier than has hitherto been recorded and, as one would naturally expect from Patten's study of *Patella,* which he quotes, it arises from a pair of folds and not from a single one as has generally been stated for related forms. In *Succinea* these two folds appear close behind the blastopore between the region of the mouth and anus, and approaching one another fuse in the median line forming an oval area. A median furrow persists for some time as evidence of the union as in *Patella.* This last fact gives some meaning to the similarly furrowed appearance occuring in *Limnæus, Planorbis* and *Ancylus.*

A study of over 100 embryo showed him that this paired origin is the rule, although examples were found where the elevation was unpaired, forming then a broad disc. In one apparently pathological case the blastopore had retained its supposed primitive elongated form and the beginning of the foot had the form of a horseshoe embracing its hinder end.

His conclusion that the foot represents the fused lips of the elongated blastopore removes the possibility of the organ being some kind of secondary formation, and makes it out to be a metamorphosed very ancient structure: and if the conclusion is correct, the molluscan foot is not quite such an anomalous structure as it has hitherto seemed.

A few remarks concerning the podocyst and the so called "Nackenblase" are of interest in that they show that the latter structure is not an organ at all, and that the contracting motions that have been observed in it are due to the contractions of the podocyst which acts as an organ of circulation. For in *Succinea* where the structure in question has an enormous development and where no podocyst occurs there are no such movements to be seen. The structure is, he says, a mass of endoderm cells swollen with albumen, the embryonal liver and the outer body epithelium.

With regard to the shell gland, Schmidt substantiates, in the main, the early observations of Gegenbaur or *Clausilia* and shows Korschelt's doubt concerning them to be unfounded. A large series of *Clausilia* embryos gave ample opportunities for study, and as a result it appears that very early the shell gland arises as an invagination of the outer epithelium, and closing up, becomes completely cut off from its parent layer. Sections show it to be completely surrounded by mesoderm. The hollow vesicle thus formed becomes flattened out so that he distinguishes in it an outer and an inner layer of cells separated by a narrow space. The outer layer remains more or less un-

changed, but the cells of the inner one proliferate and begin to lay down the shell, which may be distinguished in sections as a very thin lamina. At about this time observations of embryos by reflected light show a small invagination or hole near the center of the newly formed shell, which is thus laid bare. The hole then is of secondary formation and not, as Korschelt supposes, something that has persisted from the original invagination.

It appears then that the internal formation of the shell, as it has been generally recognized in the so called naked pulmonates is not an exception to a rule but the rule itself, and that the condition obtaining in *Limax* and others differs from that in the rest of the pulmonates only in so far as a rudimentary condition is retained in the adult animal.—F. C. KENYON, Ph. D., Clark University, Worcester, Mass.

PSYCHOLOGY.

Physical and Social Heredity.—The great courtesy of the Editor of this journal in reprinting one of my paper from *Science* preliminary to replying to it encourages me to ask him for a page or two of comment on his reply. This is the more needful since the second of my papers which he criticises may not have been seen by the readers of the NATURALIST, and the third has only just appeared in *Science*, (March 20 and April 10, 1896).

The main question at issue is the relation of consciousness or intelligence to heredity; the other matter, that of the relation of consciousness to the brain, being so purely speculative that I shall merely touch upon it at the end of this note.

Prof. Cope[1] says: "there is no way short of supernatural revelation by which mental education can be accomplished other than by contact with the environment through sense-impressions, and by transmission of the results to subsequent generations. The injection of consciousness into the process does not alter the case, but adds a factor which necessitates the progressive character of evolution." Both of these sentences I fully accept, except that the word "transmission" seem to imply the Lamarkian factor, which I think the presence of consciousness renders unnecessary. Using the more neutral word "conservation" instead of "transmission," I may refer to three points on which Prof. Cope criticises my views: first, conservation of intelligent acquisitions from genera-

[1] AMER. NAT., April, 1896, p. 343.

tion to generation; second, "the progressive character of evolution;" and third, "mental education" or acquisition.

First, agreeing as we do on the fact of mental acquisition or "selection through pleasure, pain, experience, association, etc.," Prof. Cope cites my second paper (*Science*, Mar. 20th) in which I hold that consciousness makes acquisitions of new movements by such selections. He then says, if so, then I admit the Lamarkian factor. But not at all; it is just the point of my article to refute Romanes by showing that adaptation by intelligent selection makes the Lamarkian factor unnecessary. And in this way, i. e., this sort of adaptation on the part of a creature *keeps that creature alive* by supplementing his reflex and instinctive actions, so *prevents the operation of natural selection* in his case, and gives the species time to get congenital variations in the lines that have thus proved to be useful (see cases cited). Farthermore, all the resources of Social Heredity—the handing down of intelligent acquisition by maternal instruction, imitation, gregarious life, etc.—come in directly to take the place of the physical inheritance of such adaptations. This influence Prof. Cope, I am glad to see, admits; although in admitting it, he does not seem to see that he is practically throwing away the Lamarkian factor. For instead of limiting this influence to human progress, we have to extend it to all animals with gregarious and family life, to all creatures that have any ability to imitate, and finally to all animals which have consciousness sufficient to enable then to make conscious adaptations themselves: for such creatures will have children that do the same, and it is unnecessary to say that the children must inherit what their fathers did by intelligence, when they can do the same things by their own intelligence. As a matter of fact Prof. Cope is exactly the biologist to whose Lamarkism this admission is, so far as I can see, absolutely fatal; for he more than all others holds that adaptations all through the biological scale are secured by consciousness.[2] If so, then he is just the man who is obliged to extend to the utmost the possibility of the transmission also of these adaptations by intelligence, which, as I said, rules out the need of their transmission by physical heredity. At any rate he is quite incorrect in saying that "he [I] both admit and deny Lamarkism."

To this argument of mine Prof. Cope presents no objection that I see except one from analogy. He says: "I do not see how promiscuous variation and natural selection alone can result in progressive psychic evolution, more than in structural evolution, since the former is condi-

[2] And in this I think he is right: see chaps. VII and IX of my *Mental Development* (Macmillans, 2d. ed.).

tioned by the latter." As to the word "progressive," I take up that question below; but as to the analogy with structural evolution, two answers occur to me. In the first place, Prof. Cope is, as I said, the very man who holds that all structural evolution is secured by direct conscious adaptations. He says: "mind determines movements and movements have determined structure or form." If this be true how can psychic be conditioned by structural evolution? Would not rather the structural changes depend upon the psychic ability of the creature to effect adaptations? And then, second, at this point Prof. Cope assumes the Lamarkian factor in structural evolution. Later on he makes the same assumption when he says: "But since the biologists have generally repudiated Weismannism," etc. This is a curious saying; for my impression is that even on the purely biological side, the tendency is the other way. Lloyd Morgan has pretty well come over; Romanes took back before he died many of his arguments in favor of the Lamarkian factor; and here comes a paleontologist, Prof. Osborn, —if he is correctly reported in *Science*, April 3rd, p. 530—to argue against Prof. Cope on this very point with very much the same sort of argument as this which I have made.[3] And while Prof. Cope will agree with me that this sort of *argumentum ex autoritate* is not very convincing, yet he will not object to my balancing off his dictum with the following from a letter which just comes to me from another distinguished biologist, Prof. Minot: "Neo-Lamarkism seems to me an impossible theory."

But Prof. Cope goes on to say that I "both admit and deny Weismannism;" on the ground that "his [my] denial of inheritance only covers

[3] Since writing this I have heard Prof. Osborn read a paper which confirms the agreement between him and me which I supported in the text above. I reached my conclusion independently and one of my *Science* articles gives report of it as expressed in a criticism of Romanes before the New York Academy of Science on Jan. 31st, 1896. Prof. Osborn's expression "ontogenic variations" i. e. those brought out by "environment (which includes all the atmospheric, chemical, nutritive, motor, and psychical circumstances under which the animal is reared)" seems to make these adaptations after all *constitutional*. As Prof. Osborn says this will not do for all cases; and I think it will not do for instinct, where constitutional variations without the aid of *intelligence* would never suffice (as Romanes says) to keep the animal alive while correlated variations are being perfected phylogenically. But it seems to answer perfectly where intelligent or other adaptations supplement the constitutional variations—and that is just the point made in my *Science* paper. As to the way these ontogenic variations or adaptations are brought about in the individual creature, see the remarks on "organic selection" below. I am printing in the next issue of this journal (June) a full statement of the entire position.

the case of psychological sports." But I do not see the connection. If Prof. Cope means denial of the inheritance of acquired characters then I deny it equally of sports and other creatures; but I do not deny that the native "sportiveness" (!) of sports tends to be transmitted. In my view the "massiveness of front" which progress shows (and which Prof. Cope accepts) shows that in social transmission the individual is usually swamped in the general movement as the individual sport is in biological progress. As a matter of fact, however, the analogy from "sports" which Prof. Cope makes does not strictly hold. For the social sport, the genius, is *sometimes* just the controlling factor in social evolution. And this is another proof that the means of transmission of intelligent adaptations is not physical heredity alone, but that they are socially handed down. I do not see, therefore, what Prof. Cope means by saying that I "admit and deny Weismannism," for I have never discussed Weismannism at all. I believe in the Neo-Darwinian position plus some way of getting "determinate variations." And for this latter I think the way now suggested is better than the Lamarkian way. Like many of the biologists (e. g., Minot) I see no proof of Weismannism (just as I protest mildly against being sorted with Mr. Benjamin Kidd!); yet I have no competence for such purely biological speculations as those which deal in plasms!

Second, the question as to how evolution can be made "progressive." Prof. Cope thinks only by the theory of "lapsed intelligence" or "inherited habit." Admitting that the intelligence makes selections, then they must be inherited, in order that the progress of evolution may set the way the intelligence selects. But suppose we admit intelligent selection (even in the way Prof. Cope believes); still there are two influences at work to keep the direction which the intelligence selects apart from the supposed direct inheritance. There is that of social handing down, imitation, etc., or Social Heredity, which I have already pointed out; and besides there is the survival by natural selection of those creatures which have variations which intelligence can use. This puts a premium on these variations and their intelligent use in following generations. Suppose, for instance, a set of young animals some of which have variations which intelligence can use for a particular adaptation, thus keeping these individuals alive, while the others who have not these variations die off; then the next generation will not only have the same variations which intelligence can use in the same way, but will also have the intelligence to use the variations in the same way, and the result will be about *the same as if the second generation had inherited the adaptations directly*. The direc-

tion of the intelligent selection will be preserved in just the same sense. I think it is a great feature of Prof. Cope's theory that he emphasizes the intelligent direction of evolution, and especially that he does it by appealing to the intelligent adaptations of the creatures themselves; but just by so doing he destroys the need of the Lamarkian factor. Natural selection kills off all the creatures which have not the intelligence nor the variations which the intelligence can use; those are kept alive which have both the intelligence and the variations. They use their intelligence just as their fathers did, and besides get new intelligent adaptations, thus aiding progress again by intelligent selection. What more is needed for progressive evolution?[4]

Third. We come now to the third point—the method of intelligent selection—and on this point Prof. Cope does not understand my position, I think. I differ from him both in the psychology of voluntary adaptations of movement, and in the view that consciousness is a sort of force directing brain energies in one way or another (for nothing short of a force could release or direct brain energy). The principle of Dynamogenesis was cited in my article in this form: i. e., "the thought of a movement tends to discharge motor energy into the channels as near as may be to those necessary for that movement." This principle covers two facts. First, that no movement can be thought of effectively which has not itself been performed before and left traces of some sort in memory. These traces must come up in mind when its performance is again intended. And second (and in consequence of this) that no act, whatever, can be performed by consciousness by willing movements which have never been performed before. It follows that we can not say that consciousness by selecting new adaptations beforehand can make the muscles perform them. The most that psychologists (to my knowledge) are inclined to claim is that by the attention one or other of alternative movements which have been performed before (or combinations of them) may be performed again; in other words, the selection is of old alternative movements. But this is not what Prof. Cope seems to mean; nor what his theory requires. His theory requires the acquisition of new movements, *new adaptations to environment*, by a conscious selection of certain movements which are *then carried out the first time* by the muscles.[5]

[4] I keep to "intellegent" adaptations here; but the same principle applies to *all adaptations made in ontogenesis.* I am using the phrase "Organic Selection" in the article to appear in this journal to designate this "factor" in evolution (see the next heading below).

[5] "Conscious states do have a causal relation to the other organic processes." I do not find, however, that Prof. Cope has made clear just how in his opinion the "selection" by consciousness does work.

It may very justly be asked; if his view be not true, how then can new movements which are adaptive ever be learned at all? This is one of the most important questions, in my view, both for biologists and for psychologists; and my recent work on *Mental Development* is, in its theoretical portion (chap., VIIff), devoted mainly to it, i. e., the problem of *ontogenetic accommodation.* I can not go into details here, but it may suffice to say that Spencer (and Bain after him) laid out what seems to me, with certain modifications urged in my book, the only theory which can stand in court. Its main thought is this, that all new movements which are adaptive or "fit" are selected from *overproduced movements* or *movement variations*, just as creatures are selected from overproduced variations by the natural selection of those which are fit. This process, as I conceive it, I have called "organic selection," a phrase which emphasizes the fact that it is the organism which selects from all its overproduced movements those which are adaptive and beneficial. The part which the intelligence plays is "through pleasure, pain, experience, association, etc., to concentrate the energies of movement upon the limb or system of muscles to be used and to hold the adaptive movement, "select" it, when it has once been struck. In the higher forms both the concentration and the selection are felt as acts of attention.

Such a view extends the application of the general principle of selection through fitness to the *activities of the organism.* To this problem I have devoted some five years of study and experiment with children, etc., and I am now convinced that this "organic selection" bears much the same relation to the doctrine of special creation of ontogenetic adaptations by consciousness which Prof. Cope is reviving, that the Darwinian theory of natural selection bears to the special creation theory of the phylogenetic adaptations of species. The facts which Spencer called "heightened discharge" are capable of formulation of the principle of "motor excess": "the accommodation of an organism to a new stimulation is secured—not by the selection of this stimulation beforehand (nor of the necessary movements)—but by the reinstatement of it by a discharge of the energies of the organism, concentrated, as far as may be, for the excessive stimulation of the organs (muscles, etc.), most nearly fitted by former habit to get this stimulation again,"[6] in which the word "stimulation" stands for the condition favorable to adaptation. After several trials with grotesquely excessive movements, the child (for example) gets the adaptation aimed at more and more perfectly, and the accompanying excessive and use-

[6] *Mental Development*, p. 179. Spencer and Bain hold that the selection is of purely chance adaptations among spontaneous random movements.

less movements fall away. This is the kind of "selection" that consciousness does in its acquisition of new movements. And how the results of it are conserved from generation to generation, without the Lamarkian factor, has been spoken of above.

Finally, a word merely of the relation of consciousness to the energies of the brain. It is clear that this doctrine of selection as applied to muscular movement does away with all necessity for holding that consciousness even directs brain energy. The need of such direction seems to me to be as artificial as Darwin's principle showed the need of special creation to be for the teleological adaptations of the different species. This necessity of supposed directive agency done away in this case as in that, the question of the relation of consciousness to the brain becomes a metaphysical one; just as that of teleology in nature became a metaphysical one; and science can get along without asking it. And biological as well as psychological science should be glad that it is so—should it not?

I may add in closing that of the three headings of this note only the last (third) is based on matters of my private opinion; the other two rest on Prof. Cope's own presuppositions—that of intelligent selection in his sense of the term, and that of the bearing of Social Heredity (which he admits) upon Lamarckism. In another place I hope to take up the psychology of Prof. Cope's new book in some detail.

J. MARK BALDWIN.

Observations on Prof. Baldwin's Reply.—In order to comprehend the question at issue, it is necessary to state certain fundamental principles of evolution. This process consists in the development of the heterogeneous from the homogeneous as Spencer expresses it; or in more specific language, evolution consists in the development of specialized structures from generalized material. Primitive organic or living beings consist of protoplasm which is, as compared with higher organisms, generalized. That is, they are without distinct muscular, nervous, or digestive organs, etc. How are psychic conditions related to this process of specialization? Prof. Baldwin states that an animal is able to "select through pleasure, pain, experience, association, etc., from certain alternative complex movements which are already possible for the limb or member used." This means that under guidance of a form of consciousness, certain existing muscles are selected to perform certain movements, while other muscles are neglected. Now if this be possible to a muscular system specialized into discrete bundles, it is also possible to a primitive contractile protoplasm which is not yet differ-

entiated into discrete muscular and other bodies. In other words it is possible to contract that part of the homogeneous protoplasm which is necessary for the production of a certain movement, and leave that part of the protoplasm which is not necessary to produce the movement, uncontracted. And this is exactly what undifferentiated animals (Protozoa) do, and it is what is done at all stages of differentiation of the muscular system, so far as the differentiation which that muscular system has attained, will permit. It is the sentence which I have quoted above from Prof. Baldwin which induced me to say that he admits the Lamarkian factor. For there is no doubt that it has been this habitual contraction of certain parts of undifferentiated protoplasm which has produced muscular bands, sheets, etc., as distinguished from other histological elements of the organism. If this be true, there is no necessity for the hypothesis of "overproduced movements" as the source of new habits, since those habits may be produced by the direct effect of the selective power of the animal over its own protoplasm. It is not intended by this expression to claim anything more than simple sensation for simple forms of life, or that anything higher than hunger, reproduction temperature, etc., constitute their pleasures and pains.

The theory of natural selection from "overproduced movements" as a *source* of new movements stands on the same basis as all the other theories of natural selection as explanations of the *origin* of anything new. They are impossible in practice, and inaccurate in logic, since in my opinion, following that of Mr. Darwin, they demand of Natural Selection a function of which it is by its definition incapable. That natural selection regulates the survival of movements after they have originated, goes without saying. It is evideut that "overproduced movements" must on Prof. Baldwin's "Organic Selection" theory, include the adaptive one which is destined to survive. The question then is as to the origin of this particular "overproduced" and adaptive movement. The explanation has been given above; i. e. that it is a direct response to the stimulus supplied. The location in the organism of the responsive movement depends on the location of the stimulus, a fact testified to by the close local connection of motor with sensory nerves of general sensation. In the case of responses to special sensation, we may suppose that the responses only became exact as to locality after a period of trial and error, the new movement always having a local relation to the point of stimulus. The beast bites his wound, before he has traced the pain to his enemy. As already pointed out, this process would result in a perfected mechanism which would be inherited. No one can yet explain the mechanism of the control of a mental state

over a contraction of protoplasm. It is one of the ultimate facts of the universe. When Prof. Baldwin admits that an animal can select which of two muscles it will use, or when he admits that an animal can contract any muscle under the stimulus of "pleasure, pain, etc., he admits this ultimate fact, but does not explain it.

As to the scope of Social Heredity as a factor in psychic evolution, it appears to me to be, like that of the higher intelligence, mainly restricted to the higher animals and to man. Maternal instruction among all but the higher animals probably has no existence. Imitation may be supposed to be possible to animals a little lower in the scale. But both factors are to my mind only supplementary to the more vigorous education furnished by the environment, with its wealth of stimuli to "pleasure, pain, experience, association, etc." In regarding Social Heredity as the sole factor of psychic evolution, Prof. Baldwin temporarily loses sight of the intimate connection between mind and its physical basis. The inheritance of mental characteristics is as much a fact as the inheritance of physical structure, and for the reason that the two propositions are identical. One does not believe in either education or imitation as a cause of the repetition of insanity in family lines. We rather believe in a defective brain mechanism, which is inheritable, though fortunately not always inherited. The doctrine of Weismann that acquired characters are not inherited, if true, would furnish the physical conditions for the theory that Social Heredity is the only psychic heredity, but it is impossible to believe that Weismann's doctrine is true. Hence while Social Heredity is true as far as it goes, Lamarkism is also true, and expresses the more fundamental law. The fact that no adequate physical explanation of the inheritance of acquired characters has been reached does not disprove the fact.

E. D. Cope.

ANTHROPOLOGY.[1]

Indian habitation in the Eastern United States.—Mr. Thomas Wilson of the Smithsonian Institution in a recent letter refering to a discussion in Washington as to the shape of Indian habitations east of the Mississippi, says, that while certain of the disputants "agreed that the Plains Indians of the present or modern times used wigwams made with poles fastened together at the top and spreading out in a circle at the bottom after the fashion of a Sibley tent, they

[1] This department is edited by Henry C. Mercer, University of Penna, Phila.

denied that any such structures were used by Indians, in the East. They insisted that these wigwams were confined to the plains and to the prairies and treeless countries, and did not exist, or were not found, and had never been used in the timbered countries—that in the timbered country Indian houses were made of wooden logs with upright sides and a flat or sloping roof. While I knew that many of these were made among the Iroquois of the East, and that this form was adopted in making the long houses (as they were called), I doubted whether they were so built among the nomadic and wandering tribes of Pennsylvania and the West Ohio, Indiana, etc. Can you give me any enlightenment thereon? If so, I will be obliged."

While it is not improbable that the shape of "wigwams," like burial customs varied considerably among the forest Indians, and while any camper out feels that a shelter often temporary, framed in the woods with available boughs, would vary in shape according to circumstances and suggest variation in more permanent structures, no one need hope to speak with final authority upon this subject, who has not ransacked the records of explorers, the narratives of individuals captured by Indians, the *relations* of the Jesuits, and the significant sketches of travellers in the last two centuries.

Dr. Daniel G. Brinton informs me that certain of the Brazilian forest Indians use the tepee form, and speaking of the Lenni Lenape, and quoting Nelson's History of New Jersey, writes: "William Penn describes the dwellings of the Delaware Indians as 'houses of mats, or barks of trees, set on poles, hardly higher than a man.' Pastorius states that 'young trees would be bent towards a common centre and the branches interlaced and fastened together as a frame work, and covered with bark.' Wassenaer says, 'they would construct a circular matted hut, with either angular or rounded top, thatched or lined with mats, a rent hole in the top serving for the escape of smoke.' This last description is strictly that of a tepee and shows that the angular pointed hut was in use by the Mohigan and Lenape Indians. Wassenaers' History is printed in Vol. III New York Documentary History."

The above quotation from Penn, however, if given correctly in Watsons' Annals of Philadelphia Vol. II. p., 153 reads distinctly against the tepee form. "Their houses were made of mats or barks of trees set on poles, *in the fashion of an English barn*, but out of the power of the winds for they are hardly higher than a man." And we find a rectangular structure again ascribed to the work of a band of Lenapes squatting in the suburbs of Philadelphia about 1770-80, in

Watson Vol. II. p. 31 where a person 80 years old in 1842 relates that he well remembers seeing colonies of Indians of twenty or thirty persons, often coming through the town (Germantown) and sitting down in Logan's woods, others in the present (1842) open field south-east of Griggs' place. They would make their huts and stay a whole year at a time and make and sell baskets, ladles and tolerably good fiddles. He has seen them shoot birds and young squirrels there with their bows and arrows. Their huts were made of four upright saplings with crotch limbs at top. The sides and tops were of cedar bushes and branches. In these they lived in the severest winters. Their fire was on the ground and in the middle of the area."

As the barn structure with its ridge pole would take six upright crotched saplings, this rectangle set up by half civilized indians with only four, was not barn shaped but single sloped like the simplest form of shed. The form described above by Pastorius judging from the tendency of elastic saplings when pulled together at the top to bow outward, would probably have resulted in a round roofed structure of the bee hive pattern if round at the base, or if rectangular, in such a building as De Brys' picture made in 1690 refers to Virginia Indians (Contributions to N. A. ethnology Vol. IV) or Captain John Smith carefully draws over the head of the sitting Powhatan in the upper left hand corner of his map of Virginia (see Narr. and Critical History of Am., III, 166.) But if we believe Wassenaer who distinctly describes the Sioux Tepeè we must allow the latter form to the Delawares.

Too much importance need not be ascribed to the minute realistic outlines of habitations made to stand for Indian villages upon certain old maps drawn on a large scale as for instance in Dumont de Montigny's map of Louisiana (1746), when all Indian villages are marked with tepee like points from the Illinois River to New Orleans and from the Mobile to the Misissippi Rivers. On the other hand Du Prats, in a similar map (1758) gives the barn shape.[2] In other maps the structures seem too carefully and designedly drawn to be without archæological value. As when Father Abrahams Almanac Map 1761 (Narrative and Crit. Hist. V, 497) marks seven indian towns in the tepee shape near the junction of the Allegheny and Monongahela Rivers, and Hennepin in his map (1740) of the Mississippi valley and lakes (Narr. and Crit. Hist. IV 252 and 249) and again in his map of the lake region (1683) clearly shows pointed wigwams about the head waters of the Mississippi, as against small rectangular figures for the lower valley. Hawkins describes a communal Indian house seen in Florida as

[2] Narrative and Critical History of America Vol. V. p. 66.

like a great barn in strength, not inferior to ours. Lescarbot's map of Montreal 1609. (Narr. and Crit. His. IV 304) shows the palisaded Indian village of Hochelaga with barn-shaped round-roofed rectangular structures as in John Smith's cut, and in a map of Lake Ontario and the Iroquois Country 1662-63, (from one of the Jesuit *relations*) the indian villages are barn-shaped and with pointed roofs. La Hontain suggests the same shape in his map of the lake region 1709 (Narr. Crit. Hist. IV 281-261-258) and several Indian lodges of the circular bee-hive pattern surrounded by cultivated enclosures are given by Champlain in his map of Plymouth Harbor 1605. (Narr. and Crit. History IV 109). While not only the round bee-hive pattern, but also the long rectangle with round roof, as in Smith, are carefully drawn by the same explorer in his map of Nauset Harbor, 1604-05 (Land fall of Leif Erickson by Eben Norton Horsford p. 78).

More interesting is the direct evidence of the Indians themselves. The Lenape Stone, found in the Lenape region in 1872, and whose authenticity after ten years observation I have been unable to doubt, shows three pointed figures near trees, unmistakably referring to tepee shaped habitations in the right of the drawing, and another figure similarly outlined on the reverse, (See the Lenape Stone or the Indian and the Mammoth by H. C. Mercer, Putnam, N. Y. 1885). Another stone figured by me from the same locality. (See Lenape Stone p. 94) seems again to be inscribed with three tepee like forms.

No less explicit is the tepee figure upon the so called Winnipeseogee Stone found on the shores of Lake Winnipeseogee. (See Abbotts' Primitive Industry p. 362). George Copway (See Bureau of Ethnology Report 1888-89 p. 493 and 242) shows us Ojibway drawings which doubtless refer to the same pointed form of habitation.

That the sides of the barn shaped structures when built as by the Iroqois were invariably made of logs, is not to be supposed from the statement above quoted from Wm. Penn., and the drawing by Captain John Smith. All things considered, we have reason for supposing, subject to correction from documentary investigation, that though the barn shaped and round roofed rectangular structures were common, not only the bee hive, but the true tepee form were in use by Indians in the Pre-Columbian forest east of the Mississippi.

HENRY C. MERCER.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Novia Scotian Institute of Science.—The 13th of April.—The following papers were read: Preliminary Notes on the Orthoptera of Nova Scotia. By Harry Piers, Esq. Notes on the Newt (D. *viridescens*) and on the Ring-Necked and Garter Snakes (D. *punctatus* and E. *sirtalis*.) By A. H. MacKay, Esq., LL. D., F. R. S. C., Superintendent of Education. On the Calculation of the Conductivity of Mixtures of Aqueous Solutions of Electrolytes having a common ion. By D. MacIntosh, Esq., Physical Laboratory, Dalhousie College.—HARRY PIERS, *Secretary*.

Boston Society of Natural History.—March 18th.—The following paper was read: Prof. Charles R. Cross, "The X rays." With experimental illustrations.

April 1st.—The following paper was read: Prof. William Libbey, "The Hawaiian Islands."

April 15th.—The following papers were read: Mr. M. L. Fuller, "A new occurrence of Carboniferous fossils in the Narragansett Basin. Prof. Alpheus Hyatt, "The evidence of the descent of man from the ape. A discussion upon the subject of Prof. Hyatt's followed, Prof. Thomas Dwight, Prof. C. S. Minot, and others participating.—SAMUEL HENSHAW, *Secretary*.

American Philosophical Society.—March 20th.—An obituary of Rev. W. H. Furness, by Jos. G. Rosengarten, was presented; Mrs. Cornelius Stevenson read a short paper on "Remains of Libyan Invaders of Egypt," discovered in 1895 by Mr. Flinders Petrie.

April 10.—Prof. Cope made some observations on the figures on a tablet from Nippur, pointing out the physical characters of the men and animals represented.

Academy of Natural Science, Philadelphia.—A meeting of the Anthropological Section was held the 13th of March.—The following papers were read: Prof. F. Edge Kavanagh, addressed the Section on "Right Handedness," was the subject discussed by Drs. Mills, Allen and Brinton, Professors Witmer, Culin, Jastrow and Gudeman.

Anthropological Section was held at the Academy on Friday, April 10th.—The following paper was read: Prof. Lightner Witmer on "Psycho-physical Measurement."—CHARLES MORRRIS.

New York Academy of Sciences.—Biological Section, March 9th.—Mr. F. B. Sumner read a paper on "The Descent Tree of the Variations of a Land Snail from the Philippines," illustrated by a lantern slide. Mr. Sumner described the range in variation in size and markings in the shell, and arranged the varieties in the form of a tree of three branches diverging from the most generalized type. It was shown that these several varieties occupy the same geographical region and Mr. Sumner was of the opinion that their occurrence could not be explained by natural selection since if the colorations were supposed to be protective it would be impossible to explain the evolution of these three types. Prof. Osborn, in discussion, was inclined to take the same view. Dr. Dyar, however, thought the explanation by natural selection not necessarily excluded, since the variations seemed analogous to the dimorphism in sphinx larvae, which has been shown by Poulton to be probably due to this factor.

The other paper was by Dr. Arnold Graf on "The Problem of the Transmission of Acquired Characters."

Dr. Graf discussed the views of the modern schools of evolutionists and adopted the view that the transmission of acquired characters must be admitted to occur. He cited several examples which seemed to support this view, and especially discussed the sucker in leeches as an adaptation to parasitism and the evolution of the chambered shell in a series of fossil Cephalopods.

Prof. Osborn remarked in criticism of Dr. Graf's paper that this statement does not appear to recognize the distinction between *ontogenic* and *phylogenic* variation, or that the adult from any organism is an exponent of the stirp, or constitution. The Environment. If the environment is normal the adult would be normal, but if the environment (which includes all the atmospheric, chemical, nutritive, motor and psychical circumstances under which the animal is reared) were to change, the adult would change correspondingly; and these changes would be so profound that in many cases it would appear as if the constitution, or stirp, had also changed. Illustrations might be given of changes of the most profound character induced by changes in either of the above factors of the environment, and in the case of the motor factor or animal motion, the habits of the animal might, in the course of a life time, profoundly modify its structure. For example, if the human infant were brought up in the branches of a tree as an arboreal type instead of as a terrestrial, bi-pedal type, there is little doubt that some of the well known early adaptations to arboreal habit (such as the turning in of the soles of the feet, and the grasping of the

hands) might be retained and cultivated, thus a profoundly different type of man would be produced. Similar changes in the action of environment are constantly in progress in nature since there is no doubt that the changes of environment and the new habits which it so brings about far outstrip all changes in constitution. This fact which has not been sufficiently emphasized before, offers an explanation of the evidence advanced by Cope and other writers that change in the forms of the skeletons of the vertebrates first appears in ontogeny and subsequently in phylogeny. During the enormously long period of time in which habits induced ontogenic variations it is possible for natural selection to work very slowly and gradually upon predispositions to useful correlated variations, and thus what are primarily *ontogenic variations* become slowly apparent as *phylogenic variations* or congential characters of the race.—C. L. BRISTOL, *Secretary.*

The Academy of Science of St. Louis.—March 16th.—Mr. Trelease presented some of the results of a recent study of the poplars of North America, made by him for the Systematic Botany of North America, and exhibited specimens of the several species and recognized varieties. Specimens were also exhibited of an apparently undescribed poplar from the mountains of northern Mexico, which he proposed to characterize shortly, and, for comparison, specimens of the two other species of poplar known to occur in Mexico, and of the European allies of the supposed new species, were laid before the Academy. The paper was discussed by Drs. Green, Glatfelter, and Kinner, Mr. Winslow, and Professor Kinealy.

The Academy, in co-operation with the joint committee of the scientific societies of Washington, adopted resolutions favoring the appointment of a permanent chief for the scientific work of the United States Department of Agriculture.

April 6th.—Prof. C. R. Sanger spoke on the commercial synthesis of acetylene, illustrating the flame procurable from this gas when burned with a proper proportion of air.

Prof. Sanger also presented the results of a preliminary biological and chemical examination into the ice supply of St. Louis, and exhibited a device for melting the ice in such examinations without danger of contamination from atmospheric ammonia, etc.

The Secretary presented for publication, by title, a paper by Mr. Charles Robertson, entitled "Flowers and Insects."

Mr. William H. Roever presented a paper on the geometry of the lines of force from an electrified body, in which it was shown that:

(a.) the curve representing a line of force proceeding from a system consisting of two parallel electrified lines, is the locus of the intersection of two straight lines, rotating in the same plane about these two parallel lines as axes with uniform but different angular velocities. (b.) the curve representing a line of force proceeding from a system consisting of two electrified points, is the locus of the intersection of two straight lines, rotating, in the same plane about parallel axes passing through those points, in such a manner that the versines of their angles of inclination to the plane of the axes change at uniform but different rates.

April 20th.—Dr. C. M. Woodward presented the results of a study of certain statistics of school attendance, from which it appeared that the average age of withdrawal from the public schools in three cities compared was as follows: Boston, 15.8; Chicago, 14.6; St. Louis, 13.7.

Professor J. H. Kinealy exhibited and gave a mathematical discussion of the Stang planimeter, an interesting and simple instrument of Danish invention, but improved in the United States.

WILLIAM TRELEASE, *Recording Secretary.*

U. S. National Academy of Sciences.—April 21, 1896.—The following papers were read: The Geological Efficacy of Alkali Carbonate Solutions, E. W. Hilgard; On the Color Relations of Atoms, Ions and Molecules, M. Carey Lea; On the Characters of the Otocœlidæ, E. D. Cope; Exhibition of a Linkage whose motion shows the Laws of Refraction of Light, A. M. Mayer; Location in Paris of the Dwelling of Malus, in which he made the discovery of the Polarization of Light by Reflection, A. M. Mayer; (1) On Experiments showing that the X-Rays cannot be Polarized by passing through Herapathite; (2) The Density of Herapathite; (3) Formulæ of Transmission of the X-Rays through Glass, Tourmaline and Herapathite, A. M. Mayer; On the X-Rays from a Statical Current produced by a Rapidly Revolving Leather Belt, W. A. Rogers and Frederick Brown; Biographical Memoir of James Edward Oliver, G. W. Hill; Biographical Memoir of Charles Henry Davis, C. H. Davis; Biographical Memoir of George Engelmann, C. A. White; Legislation Relating to Standards, T. C. Mendenhall; On the Determination of the Coefficient of Expansion of Jessop's Steel, between the limits of 0° and 64° C., by the Interferential Method, E. W. Morley and W. A. Rogers; On the Separate Measurement, by the Interferential Method, of the Heating Effect of Pure Radiations and of an Envelope of Heated Air, W. A. Rogers; On the Logic of Quantity, C. S. Peirce; Judgement in Sensation and Perception, J. W. Powell; The Variability in Fermenting Power of the Colon

Bacillus under Different Conditions, A. W. Peckham (Presented by J. S. Billings); Experiments on the Reflection of the Röntgen Rays, O. N. Rood; Notes on Röntgen Rays, H. A. Rowland; Some Studies in Chemical Equilibrium, Ira Remsen; The Decomposition of Diazo-compounds by Alcohol, Ira Remsen; On Double Halides containing Organic Bases, Ira Remsen; Results of Researches of Forty Binary Stars, T. J. J. See; On a Remarkable New Family of Deep-sea Cephalopoda and its bearing on Molluscan Morphology, A. E. Verrill; The Question of the Molluscan Archetype, an Archi-mollusk, A. E. Verrill; On some Points in the Morphology and Phylogeny of the Gastropoda, A. E. Verrill; Source of X-Rays, A. A. Michelson and S. W. Stratton; The Relative Permeability of Magnesium and Aluminum to the Röntgen Rays, A. W. Wright; The State of Carbondioxide at the Critical Temperature, C. Barus; The Motion of a Submerged Thread of Mercury, C. Barus; On a Method of Obtaining Variable Capillary Apertures of Specified Diameter, C. Barus; On a New Type of Telescope Free from Secondary Color, C. S. Hastings; The Olindiadæ and other Medusæ, W. K. Brooks; Budding in Perophora, W. K. Brooks and George Lefevre; Anatomy of Yoldia, W. K. Brooks and Gilman Drew; On the *Pithecanthropus erectus* from the Tertiary of Java, O. C. Marsh.

C. D. Walcott and R. S. Woodward were elected members.

SCIENTIFIC NEWS.

Prof. Charles L. Edwards of the University of Cincinnati is to open a biological station this summer at Biscayne Bay, Florida. The place is well situated for the study of the tropical and sub-tropical flora and fauna, while its situation upon the continent makes it more readily accessible than the West India Islands. There will be opportunity for investigation while less mature students will have lectures and laboratory instructions. The session begins June 22d, and continues six weeks. A laboratory fee of $25,00 covers tuition, use of apparatus, reagents, etc., and Prof. Edwards estimates the total necessary expenses of each student, including board, railroad fares, etc., at from $100 to $125. It is also proposed to open a department of laboratory supply and to furnish all available material properly prepared at reasonable rates. For further information address Prof. Edwards at the University of Cincinnati.

Among the recent appointments to honorary membership in Learned Societies we notice, Sir W. H. Flower, by the Swedish Academy of Science; Prof. E. Ray Lankester, by the Russian Academy of Science; A. N. Beketow, Prof. Jas. Hall, Charles D. Walcott and Dr. G. Retzius by the St. Petersburg Academy of Science.

Dr. G. Lawson, botanist, of Halifax, N. S., died December 10th, 1895. It was owing to a confusion in names that the report of the death of the Canadian geologist, G. Dawson, arose.

The French Association for the Advancement of Science held its meeting this year at Tunis, from April 1 to 11. The Botanical Society of France, met at the same time and place.

Dr. George Baur, of the University of Chicago, will spend the summer in Munich, his former home, where he will study the rich paleontological collections of the University.

An expedition started, the middle of March to explore the interior of New Guinea. Dr. Lauterbach the leader takes charge of the botany, Dr. Kersting of the zoology.

The report of the death of the botanist K. Wilhelm, of Vienna is an error, caused by a confusion of names, his brother G. Wilhelm having died Nov. 30th, 1895.

Dr. H. M. Ward, of Cooper's Hill, England, accepts the Professorship of Botany in the University of Cambridge as successor to the late Professor Babbington.

Prof. K. G. Huefner, of Tübingen, has been called to the University of Strasburg where he succeeded the late Prof. Hoppe Seyler in the chair of Physiological Chemistry.

Prof. F. von Sandberger, who recently celebrated his fifty year Doctor-jubilee, has retired from the Professorship of Mineralogy in the University of Würzburg.

Prof. W. A. Locy, for several years Professor of Biology in Lake Forest University goes to Northwestern University, Evanston, Ill., as Professor of Zoology.

H. A. Miers, assistant keeper in the British Museum, goes to the University of Oxford as Professor of Mineralogy, succeeding the late Professor Maskelyne.

Dr. H. Schauinsland, of Bremen, has gone to the Island of Laysan for a ten month's exploring expedition, intending to study both the flora and fauna.

Dr. Looss, for several years docent in the University of Leipzig, has been advanced to the position of Extraordinary Professor.

Dr. E. Sickenberger, Professor of Botany and Chemistry in the medical school of Cairo, Egypt, died December 10th, 1895.

Dr. L. Edinger, of Frankfort, A. M. well known for his researches on the brain, has been honored with the title of Professor.

Dr. F. Saccardo, has been appointed Professor of Plant Pathology in the school of Oenology and Viticulture at Avellino.

Dr. P. Tauber, of Berlin, has sailed for South America intending to study the plants of Brazil, Venezuela and Guinea.

Dr. G. Wagener, Professor of Anatomy in the University of Marburg, died February 10th, 1896, at the age of 70.

Dr. F. Hochstetter, formerly of Vienna, goes to the University of Innsbruck, as ordinary Professor of Anatomy.

Dr. Katzer, has been elected Director of the Mineralogical-Geological section of the Museum of Para, Brazil.

Dr. L. Neumann has been appointed Ordinary Professor of Geography at the University of Freiberg.

Dr. E. Topsent, of Rheims, has been called to the chair of zoology in the Medical School at Rennes, France.

Dr. Seidentopf, of Bremen, has been appointed Assistant in Minerology in the University of Göttingen.

Dr. G. Horvath of Budapesth has been appointed Director of the Royal Hungarian Museum, zoological section.

Lieut H. E. Barnes, well known through his studies of Asiatic ornithology, died recently at the age of 48.

Dr. A. Schadmberg, an investigator of the flora and ethnology of the Philippines, died recently in Manila.

Count J. von Bergenstamn, the well known student of the Diptera, died January 31, 1896 in Vienna.

Dr. A. Zimmermann, becomes Private docent in Vegetable Physiology in the University of Berlin.

Dr. L. Buscalone, of Turin, goes to the University of Göttingen as Assistant in Plant Physiology.

G. C. Druce has been elected Custodian of the Fielding herbarium of the University of Oxford.